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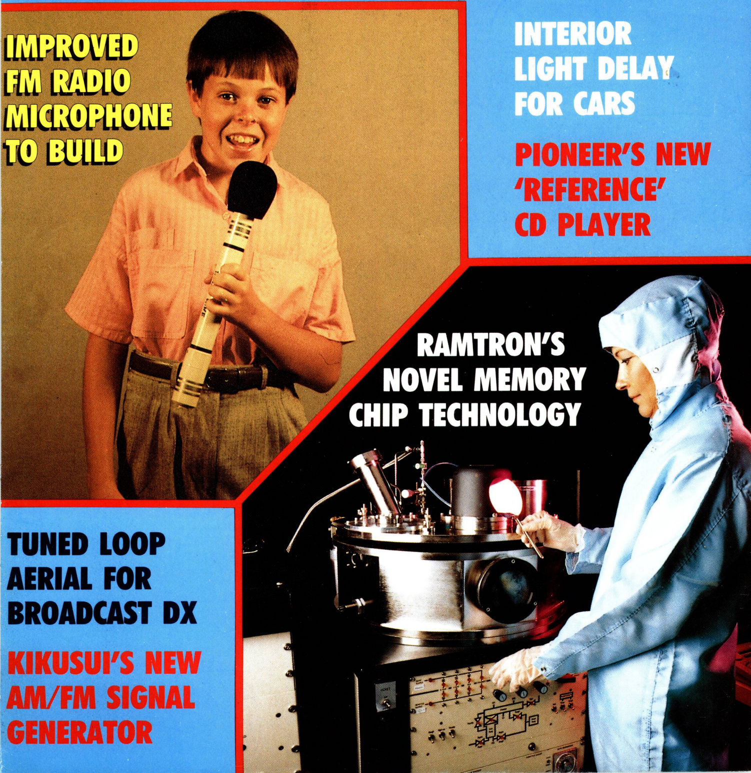

IMPROVED FM RADIO MICROPHONE TO BUILD

INTERIOR LIGHT DELAY FOR CARS

PIONEER'S NEW 'REFERENCE' CD PLAYER

RAMTRON'S NOVEL MEMORY CHIP TECHNOLOGY

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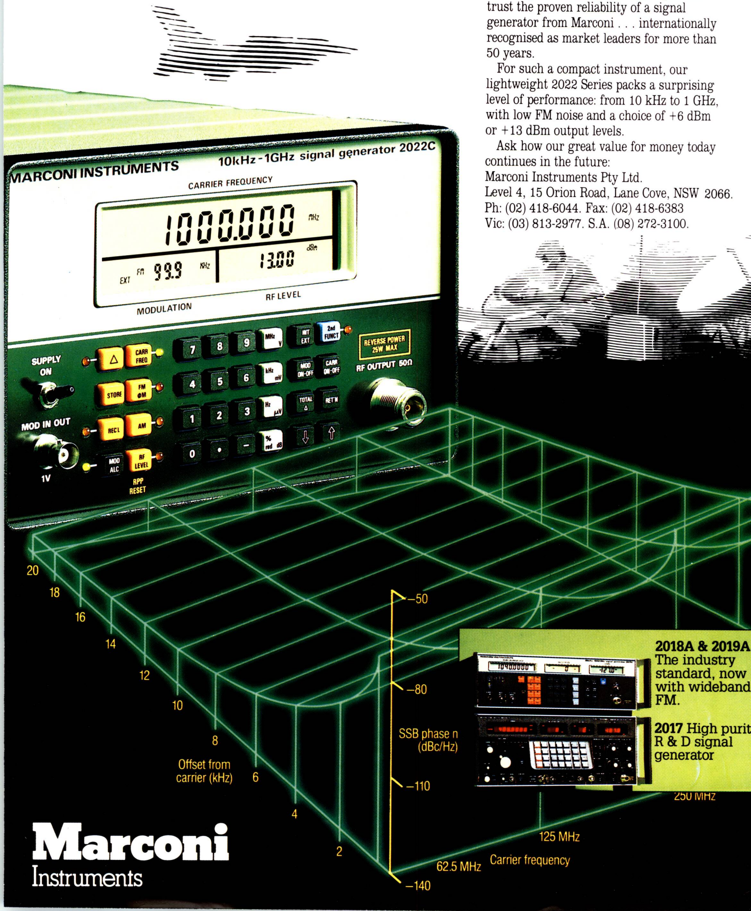


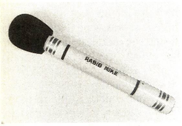
Volume 51, No.6

Electronics Australia

June 1989

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE – ESTABLISHED IN 1922

Improved FM radio microphone



Many designs for FM radio microphones have relatively poor frequency stability, omit refinements such as audio pre-emphasis, and have a crude 'dangling wire' antenna. Here's one that solves all these problems. (See page 68)

Teletext decoder

Adding Teletext capabilities to your TV/VCR combination is now easier than ever before, thanks to the latest VSLI chip set. This proven design is easy to build, and features an IR remote control. See page 84.

New memory chips

An exciting new type of memory chip using 'ferroelectric' storage looks set to replace almost all of today's DRAMs, SRAMs and EPROMs. Our feature article starting on page 32 explains how the new chips work.

On the cover

Technical Editor Peter Phillips couldn't resist taking this picture of his young son Darryl, trying out the prototype of our new FM radio mike design. The lower pic shows a wafer about to be coated with PZT, at Ramtron's fabrication plant. (See our story on page 32.)

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Letters to the editor

Bouquet, request

Even though I'm not actually involved directly in the electronics industry nowadays, I'm still very interested in electronics – and I found an incredible amount of interesting reading in your special '50th Anniversary' April issue. I must congratulate you and your editorial team on a job well done. Now I'm a publisher myself, I know how much work would have been involved in producing an issue of that size!

By the way, I was especially keen to read your article on '50 Years of Hobby Projects', and in particular the mention made on page 102 of John Moyle's historic 5" TV Receiver design, originally described in the September-October 1957 issues. I started to build one of these myself, but for various reasons never finished it.

If one of your readers has one of these sets gathering dust in the cupboard, I'd be very interested in acquiring it for my collection.

Thanks again for a memorable issue of *EA*, and for the little souvenir of the April 1939 issue – it was great!

Dick Smith
Australian Geographic,
Terrey Hills, NSW

Vibrator radios

I have noticed, with a certain amount of wry amusement, a couple of items in regard to vintage radios in your recent issues. In the March issue, there was a query about a vibrator radio. In general the answer was correct, but there is little in common between a vibrator car radio, and a mantel or table model. The set in question would work off a 6 volt accumulator, and the consumption would be possibly a little more than one amp. It would use the 2 volt series of valves, and the consumption would depend on how the filaments were connected. The car radio would use 6 volt valves, which would be much heavier on both heater and plate current.

Also, I cannot recollect seeing a set in which the HT was rectified by a diode valve. Invariably it was rectified by a separate set of contacts on the vibrator.

The other item was in the Serviceman section, a bit further back. It concerned, if I remember rightly, an open grid resistor on a 6V6 valve. The serviceman replaced it with a 100,000 ohr resistor.

The thing to remember here is tha the grid resistor is in parallel with th preceding plate resistor. If the voltag amplifier was a triode valve, the plat resistor would not be less than 100,00 ohms, therefore the same value resisto in the grid of the following valve woul effectively halve the gain of the voltag amplifier. If it was a pentode, the plat load would be at least 250,000 ohms and the effect would be worse. Th usual grid resistor for a 6V6 wa 500,000 ohms.

The wry amusement is due to the fac that I have suddenly realised how lon ago it was that I worked in Philips service department – I am 83.

L.E. Thomas
Balcatta, WA

Comment: Thanks for your advice, M Thomas. As I recall, both kinds o vibrator were used – the 'synchronous type, with the second set of 'rectifying contacts, and the 'non-synchronous' typ which were used in conjunction with valve rectifier.

RCA, 'phone' plugs

I am writing with regard to Pete Phillips article in the February issue o cables and connectors. It was a good article, but I beg to differ with respect t phono, phone and RCA plugs and sockets. I should qualify myself by stating that I grew up and received my basi training in electronics in the USA Therefore I realise you may have don it differently here.

The correction is that the 'phono plugs referred to in the text and the photo o page 46 are in fact 'phone plugs' and that the 'RCA types' are phono plugs.

I serviced a lot of audio equipment i the US, going back to monophoni valve gear. The 'RCA/phono' plug were invariably used to connect th tone arm/cartridge to the amplifier/tune chassis. RCA made a lot of home consumer electronics in those days and introduced the 'RCA phono' plug standard, to the best of my knowledge.

'Phone plugs' were used primarily o radio receivers, with a short wave capability and amateur radio equipment.

To answer the question in my own mind I checked catalogues by Dick Smith, Jaycar, Altronics, Geoff Wood, Rod Irving, and Tandy. All with the exception of Tandy referred to both as jacks, plugs, connectors, etc, with some having correct reference to RCA. Tandy correctly referred to phone plugs as phone plugs.

David Hire,
Annandale, NSW

Comment: You're quite right, David – we should have spotted the error ourselves.

Bogus transistors

Further to your references in June and July 1988 issues of *EA* regarding bogus versions of MJ15003/4 transistors turning up in the marketplace, I was a bit suspicious when supplied with some BU208 transistors recently by one of my regular suppliers. They too, were encapsulated in the now obsolete aluminium case and the Motorola logo on the device looked rather bogus also. However I purchased them in good faith, and used one to replace a leaky line output transistor in a recent repair job.

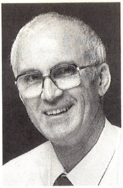
The set sprang into life, but I was rather concerned by the very high heatsink temperature for the replaced transistor. Sure enough, the set failed soon afterwoods, and after much fruitless work I replaced the transistor with a 2SD350 of known origin. The set now works very well, with the line output transistor heatsink running only mildly warm.

Thus alerted, I cut open one of the offending transistors to find a very small die, (about 1/4 the size of a 2SD350 die). It thus appears that these bogus power transistors are not exclusively audio power transistors. I trust this information is helpful to other readers.

In closing, may I express appreciation for the way in which *EA* is going these days under your editorial guidance. I particularly appreciate your balanced and sensible approach to the practice and 'politics' of electronics.

Grant Wills,
Clarence Park, SA

Comment: Thanks for the information, Grant – and also for the compliment.



Editorial Viewpoint

What's wrong with our science and technology?

One of the highlights of this issue is the feature article on Ramtron's new ferroelectric RAM chip technology, starting on page 32. It's a very exciting and significant development, I believe, and I hope that like me you'll be glad to learn that an Australian company is taking such a leading role in this pioneering area.

But wouldn't it have been great if the *actual R&D* on ferroelectric RAMs could have been done here, as well as the management and fund raising – instead of in the USA? It seems a great pity that the conditions in this country for science and technology are such that entrepreneural firms like Ramtron are forced into getting this crucial work done overseas.

Why is it that science and technology seem to be faring so badly in Australia nowadays? Government funding for research seems to be down, in real terms; private investment seems to be down; interest seems to have waned in science and engineering as careers (judging by university enrolments); scientists are apparently being forced to go overseas to work on the research that interests them; and the country seems to be drifting into a state of scientific apathy, if not antipathy.

Personally I find this very disturbing, and I feel sure that it augurs badly for the country's future.

What makes it all so ironic is that Australia's scientists and engineers are equal to those anywhere in the world, and can achieve just as much – given half a chance (which generally speaking, is about all they've ever been given). You only have to see the work that has been done, and is still being done in the CSIRO, the universities and our other research organisations, to be convinced of this.

I know that people like Barry Jones, John Button and others have been doing a lot to improve the status and funding of Australian science and technology. But somehow, despite these efforts, we still seem to be slipping slowly backwards.

The real cause of this, I suspect, is the negative way that Australians as a whole view science and technology. They blame them (wrongly) for things like pollution, galloping consumption of finite resources and the destruction of our forests – when in reality, these disciplines represent our only real hope in finding solutions to these problems (which are mainly due to human greed, surely).

Here at *Electronics Australia* we are committed to explaining and popularising the electronic aspects of both science and technology, particularly those with an Australian flavour or relevance. I hope you find our efforts worthwhile – including this month's story on Ramtron.

Jim Rowe

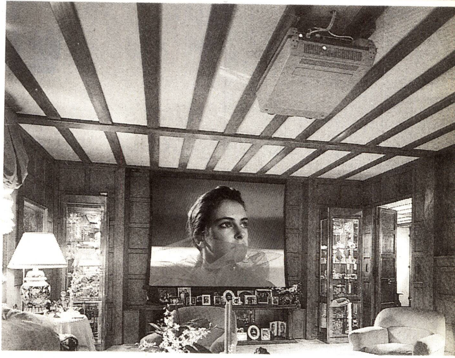
What's New In
Entertainment Electronics

High definition projection TV

Australian distributor Trace Technology expects to create a major impact with its launch of the Barcovision 600C projector, particularly in the home entertainment market.

The Barcovision 600C has as standard equipment hybrid lenses that were developed specifically for high resolution data projection. The lenses carry an optical resolution specification of an amazing 1600 lines – double that offered by other projectors.

Furthermore, the high contrast ratio of these lenses makes for an even more dazzling picture. A modern science fiction film, for instance, will show an almost 3-dimensional image of a deep black outer space with tiny pinpoints of light, compared with flat, grey images from other projectors.



Barcovision projectors can function on any television standard, including the 's' outputs of the new S-VHS video recorders. It can source from VCR, video disc players, off air tuners, satellite receivers, or video cameras. It can be used for front or rear screen projection, on flat or curved screens, and can be mounted on the ceiling or on the coffee table.

There is even an RGB input for use with computers and decoders that have RGB outputs.

For futher information contact Trace Technology, 200 Rouse Street, Port Melbourne 3207 or phone (03) 646 5833.

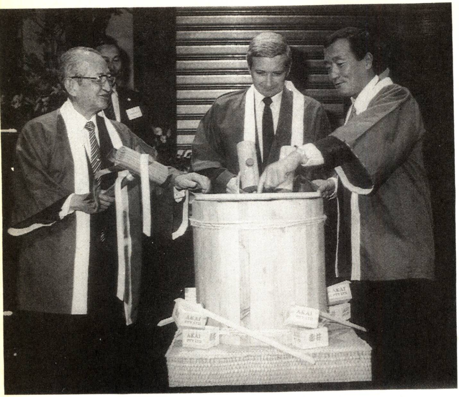
'Furniture-look' hifi systems

A new 'furniture look' range of high performance sound systems has been launched in Australia by Sanyo.

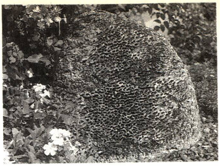
Specifically designed to blend into a modern day family living environment the new range includes a cordless remote 15 watt per-channel sound system. The Sanyo GXT 848S also features a five band graphic equaliser and 18 preset channel selectors as well as a dual cassette deck synchronised for high speed dubbing. The GXT 848S has two-way full range speakers and auto touch tuning, with LCD read-out and a semi-auto belt drive turntable.

The other Sanyo system introduced, the GXT 828S, is a 10 watt per channel RMS system with a three-band graphic equaliser. This system has touch tuning with LCD read-out as well as similar features to the larger GXT 848S.

NSW Premier opens Akai's new building



Akai has formally opened its Australian Head Office at the newly developed industrial estate (Australia Centre) at Homebush Bay, in Sydney. To officiate at the occasion the NSW Premier, The Honorable Mr Nick Greiner MP, Akai's President, Mr Maroto Okada, and the Director of Overseas Business A/V Products, Mr Toshio Nemoto were adorned in traditional Japanese attire and proceeded with the traditional Japanese 'saki barrel breaking' ceremony, an ancient Japanese custom symbolising success to a new venture. They then declared the building officially open.



Outdoor 'rock' speakers

The latest outdoor, weatherproof speakers are inside rocks – and they've just arrived in Australia.

'Rockustics' speakers are designed to be hidden amongst ferns and shrubs bordering outdoor entertaining areas, providing full fidelity sound from a speaker that blends into garden landscaping.

Made in (of all places!) Boulder, Colorado, each speaker enclosure is individually hand crafted from natural materials to guarantee the uniqueness of each stone, and can be colour-matched to the sandstone, granite, shale or other rock you have in your garden.

The 'Rock' contains two speakers; a 6.5" bass driver and a 1" high frequency tweeter, fluid cooled for higher power. These 100 watt 'rocks' have enough power to get a party rolling, and under normal conditions never need servicing.

Available for the first time in Australia, Rockustics speakers are imported from the USA for Len Wallis Audio, Lane Cove and cost around $600 each.

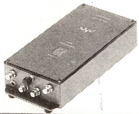
New VHS-C camcorder from JVC

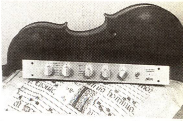
The newest and most advanced member of the JVC camcorder lineup, the GR-A30EA, achieves a previously unattainable level of picture quality at a very affordable price. The GR-A30 uses 420,000 pixels and has completely automatic operation, combined with a flying erase head, high speed shutter and 'children's age' insert, making it the ideal camera for the family, according to JVC.

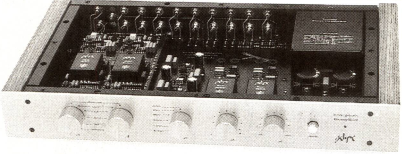
Anthony Toope of JVC explained "Our research has shown that people wish to buy a fully-featured camera without having to worry about too many buttons. Making this possible is the GR-A30's fully-automatic features such as the full-range auto focus, exclusive to JVC, which enables the videomovie to focus on any subject, at any distance from the lens, with no additional manual macro setting."

60% of people that purchase videomovie cameras do so to record family events, therefore, the ability to record the day, the date, as well as the age of a child proves to be a very useful feature, as well as adding a particularly personal touch", he added.

Distributor for Klyne Audio Art







Audio Active has recently secured sole distribution rights to distribute and service the prestigious range of Klyne Audio Art preamplifiers, head amplifiers, and shortly to be released power amplifiers.

Commenting on the appointment Audio Active manager, Nick Bajenov said "Australian audiophiles were tired of importers bringing in esoteric brands with no local marketing or service expertise to support their products". Mr Bajenov further added, "I have carefully selected a product that would be second to none in both performance, appearance and reliability".

The Klyne Audio Art line up consists of: SK-6 and SK-5A stereophonic preamplifier and the SK-2A moving coil preamplifier. The SK-6 can be purchased with either low level inputs for moving coil and moving magnet cartridges, or high level inputs for CD, tuner and auxiliary. The upgrade to phono level inputs can also be retro-fitted to the SK-6.

The design topology of the circuit evolves from the highly acclaimed SK-1MC step-up amplifier. The SK-6 employs 'music modules' which are dedicated amplifer modules specifically designed to operate in a very linear mode of operation, maximising tonal accuracy and keeping harmonic components to immeasurable amounts.

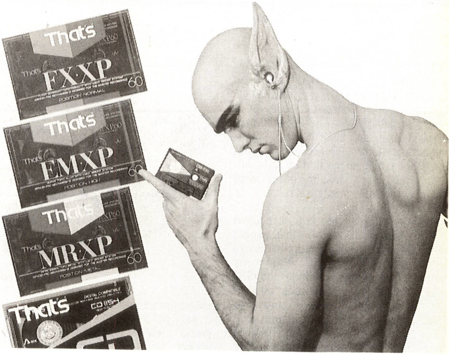
The 'music modules' are not operational amplifiers but proprietary amplifier devices designed for exceptional clarity and low distortion. Each music module is individually optimised, calibrated and selected for its respective function in the circuit.

The SK-6 with the optional RIAA phono preamplifier has three gain settings to accommodate all types of phono cartridges available (37, 50, or 63dB at 1kHz). Each gain setting has its own RIAA network and each network is individually calibrated at the factory to ensure RIAA accuracy at each gain level.

Input impedance can be selected between 15 ohms and 247k and in addition a passive high frequency contour network can be selected to compensate for high frequency rise found in most MC cartridges – also both input impedances and high frequency contours are independent of gain settings and therefore can be individually set for any type of cartridge.

The SK-6 has an RRP of $2990, the SK-6 with RIAA phono preamp has an RRP of $3990.

'That's' tape is here



'That's' cassette tape, claimed to be the most superior commercial audio tape sold throughout the world, is now available on the Australian market.

That's International and Taiyo Juden in Japan have appointed the Melbourne based company Atsui (Sansui Hi Fi and Audio, Jansson Loudspeakers, and Castell Audio Accessories) as sole distributors in Australia.

That's will tackle the $80 million blank cassette market with a range of products that has won rave reviews and scooped major awards pools in Britain and Europe during 1988.

Abbey Road, the UK's most prestigious recording studio, has stated "Using That's tape is the ultimate sound experience".

That's is available as professional quality tapes, also specifically designed to cope with compact disc and digital sound requirements.

Laser pickup for vinyl discs

Japanese audio equipment maker CTI is reported to have developed a turntable for conventional vinyl records which incorporates an integral optical laser pickup, to replace the conventional pickup and stylus. The semiconductor laser beam automatically tracks the record grooves, and simultaneously reads the left and right channel stereo audio.

Completely free from physical contact with the disc surface, the laser pickup obviates all groove wear. It is also claimed to be free from rumble pickup and acoustic feedback effects.

The player is expected to sell for around $4000.

Akai announces 'digital' HQ VCR

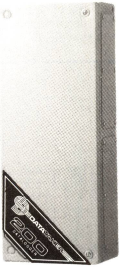
Akai's latest digital HQ VCR is packed with a host of features. The VS-66 offers, briefly: digital picture, digital freeze, HQ system, 8 program/one month timer, 100 channel pre-select, universal remote (learn) controller and Akai's Quick Start features. Akai further claim the VS-66 is the only digital VCR with 2-speed operation.

The company has taken a different approach with design layout of the VS-66, with the main transport controls on the right of the unit rather than in a horizontal strip.

One of the main benefits of 'digital' VCR's is their ability to process the TV signals so that the picture can be instantly frozen. This 'digital processing' not only enhances the picture quality but offers tremendous scope to process the picture.

The most notable feature included in the VS-66 is the 'P in P' (picture in picture) feature. A sub-screen of approximately 1/9 the main screen size can be positioned in any one of the screen's four corners. It can also allow you to have sound from the sub-screen through the VCR headphone socket.

This feature allows you to watch two sources at once. For example it is possible to view a video and a TV broadcast simultaneously. A one touch switch enables reversing back from one picture to another, or re-positioning of the sub-picture in any corner.



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Hifi Equipment Review:

Pioneer's PD-91 'Reference' CD player

The new 'Reference' model PD-91 has taken its place at the top of the Pioneer CD player range, and offers virtually all of the latest refinements. Here's a rundown on the features it offers, together with a report on what we found when we tested a sample unit.

As befits a latest-generation top of the range CD player, Pioneer's new PD-91 is physically quite impressive. Like the only other 'pro quality' model CD player we have looked at lately, it is quite large: at 458 x 430 x 129mm, it is at least as big as the majority of domestic stereo amplifiers. And very solidly made, too, with a weight of 11.7kg. Much bigger and heavier than your average CD player, to be sure.

Yet despite this massive size and weight, the PD-91 is not actually intended for professional or broadcasting use – although it would no doubt be quite suitable for much of this work. Rather, like other components in the Pioneer 'Reference' range, it is designed primarily for the top end of the domestic hifi market. The styling is in subdued black and very dark grey, with dense chipboard dress side panels finished in rosewood veneer, and a compact matching IR remote control unit.

Like most current CD players it has a front-loading roll-out disc drawer, which as usual is over on the left of the front panel. The fluorescent display panel is in the centre, with the main array of control and programming keys on the right. The main keys are for Play, Pause and Stop, with smaller track number select keys, editing and programming keys above and Track Search, Manual Search and Index Search keys below.

Beneath all of the control keys on the right is the 6.5mm jack socket for stereo 'phones, with its own volume control, while under the display is the usual OPEN/CLOSE button and five small auxiliary control buttons. These control Display On/Off (allowing the fluorescent display to be disabled if desired, for lower noise); Time display mode (elapsed, remaining or total); Auto Space On/Off (optional 3 seconds pause between tracks); Repeat (for track repeat play); and Random Play. Then further over on the left, under the disc drawer, are the power switch key and – unusually – an output mode selector switch.

This latter switch allows selection of either the usual 'analog' audio outputs, for feeding to a conventional amplifier, or direct digital outputs for feeding to a 'digital' amplifier with its own D-to-A converters, or both. In each of the single-mode positions the unrequired output circuitry is disabled, to prevent any possibility of a detrimental effect on sound quality.

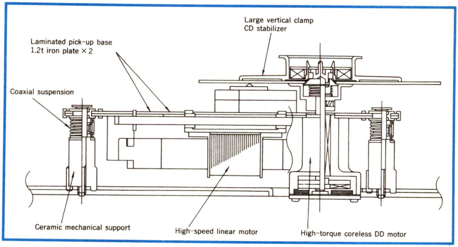
At the rear of the PD-91 case, the most prominent feature is the 'outboard' power transformer. As well as being shielded this is mounted externally, with the idea of again minimising any possible deterioration in sound quality due to stray field.

In fact the transformer is als mounted resiliently to the case proper presumably to minimise any possibl mechanical vibration due to magnetostriction. Because the mounting is quit compliant and the transformer quit heavy, removable screws are used to anchor the transformer in position fo transport. These are then removed fo operation, along with a special ke which fits to the underside of the playe to anchor the actual player mechanism.

The other features of the rear pane are the two analog and single electrical digital outputs, all via high quality gold-plated RCA connectors; the optical digital output, via the now fairly standard keyed rectangular fibre-optic connector; and of course the mains cord entry. Like many current items of hifi gear the PD-91 is double insulated.

Inside the case, there is evidence of a great deal of care having been taken to obtain high levels of both performance and reliability. Although of pressed metal the main chassis employs 'honeycomb' construction for high rigidity, and virtually all internal metalwork is heavily copper plated for high surface conductivity.

The basic player mechanism is sup-



A cutaway drawing showing the construction of the PD-91's player mechanism. A coreless motor drives the spindle directly.

Front view of the new Pioneer 'Reference Series' PD-91 player, complete with IR remote control.

ported on rigid ceramic pillars, coupled with damped spiral springs for decoupling. The player frame is made very rigid with laminated iron stampings, again copper plated, while the actual moving 'pickup' sled is a precision plastic moulding. A high-torque coreless direct drive motor is used for the disc spindle, while a high speed direct drive linear motor is used for the sled actuator.

To minimise disc vibration while playing, the PD-91 uses a special magnetically-actuated stabiliser. This is somewhat larger in diameter than in most players – about 80mm – which should give quite good damping and stabilisation.

Special precautions have been taken to prevent interaction between the digital and analog sections of the circuitry. These include separate PC boards, extensive shielding and a separate power supply system. In fact the power transformer has 4 separate secondary windings, with an array of rectifiers and some 11 different regulators, to produce a total of 16 different supply rails for various parts of the circuit.

On the functional side, the PD-91 uses Pioneer's 'Accu-Focus' system of delaying the signals produced from laser pickup's the 'leading' pair of photodetectors, to allow more accurate summing with that produced by the 'trailing' pair. This gives higher signal output, and hence an improved signal to noise ratio.

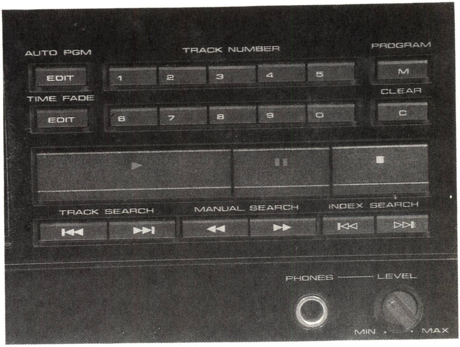
To give improved phase response/-group delay and high-end flatness, it also uses a digital filter with 8-times oversampling. This gives sampling noise components centred on 352.8kHz, allowing a relatively gentle low-order analog filter to be used after D-A conversion. And the twin DACs are said to have true 18-bit resolution, giving exceptional resolution, linearity and low distortion.

Rated THD it is in fact less than .0015%, close to the theoretical limit for CDs. Other EIAJ rated specs are a frequency response of 2Hz – 20kHz flat within 0.3dB; S/N ratio of better than 114dB; dynamic range of more than 99dB; channel separation of better than 109dB; and wow and flutter less than .001% weighted peak. Rated analog output voltage level is 2V, with the digital output 0.5V p-p into 75 ohms and the optical output between – 20dBm and -15dBm.

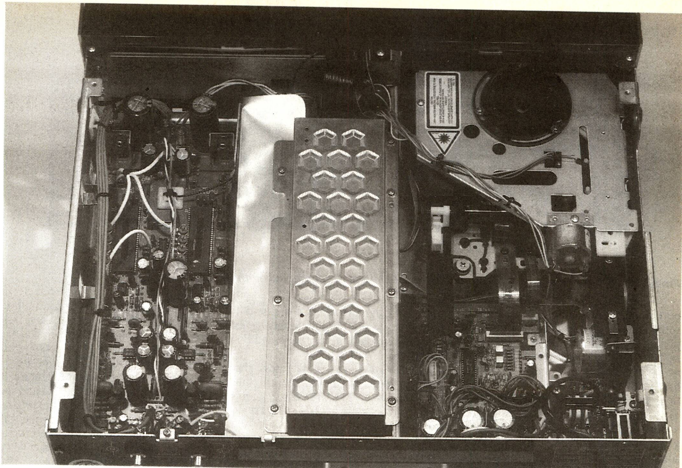
Additional operating features of the PD-91, apart from all of the usual facilities, include one-touch fade in and fade out, via keys on the IR remote control, with programmable fading time (0 - 10 seconds); a 'music window' feature for producing programmed fade in and fade out segments of music during program play (up to 8 windows can be programmed simultaneously); auto program editing; and the ability to play 80mm 'CD singles' as well as normal 120mm CDs.

What we found

Predictably, the performance of the PD-91 on the test bench was most im-



A close-up shot of the main control keys, with the stereo phone jack and its volume control at bottom right.



Inside the case of the PD-91, there is plenty of shielding and isolation between digital and analog circuitry. The large-diameter disc stabilised is visible in the top right-hand corner.

pressive indeed. Incidentally we checked out many of the performance aspects using both the Philips 410 055-2 'Test Sample 3' and Denon 38C39-7147 'Audio Technical CD' discs, to cross-check the results, with the Philips 814 126-2 'Test Sample 5A' disc used for the tracking tests.

As with most CD players the frequency was almost exactly flat (within 0.1dB) from 20Hz to 20kHz – in this case particularly when playing recordings made with 'Emphasis' off. For recordings made with Emphasis on, there was a very slight droop and then a peak at the very top end, both less than 0.5dB and of no real significance.

However unlike quite a few other players, this performance was obtained not just at the 0dB level, but also mirrored closely at levels of -20dB, -40dB and -60dB as well. And overall the linearity was excellent, tracking within a fraction of a dB down to the -80dB level, and quite possibly even further down (the reading error of our instruments tends to make firm conclusions difficult at these very low levels).

The output audio waveform all frequencies was an excellent sinewave, at least at levels down to about -60dB. Needless to say it gets rather 'steppy' at the levels below about -70dB, because there are so few bits left to provide relative resolution. But this is a limitation of CD technology, not the PD-91. Even down at -90dB it was giving an exceptionally *clean* stairstepped wave, which still measured within 2dB of the correct level! This speaks very well for the player's front-end signal handling, DAC linearity/monotonicity and filter performance.

The outputs of the two analog output channels measured within 0.2dB over the full frequency and amplitude range, while channel separation was certainly better than 101dB – more or less the limit of reliable measurement of our current test gear.

This was also the effective figure we obtained for both signal to noise ratio and dynamic range – i.e., 101dB. But in the case of S/N ratio this almost certainly reflects the limitations of the test gear, rather than the PD-91.

Turning the fluorescent display on or off produced no discernable difference to the S/N figure. Nor was there any measureable difference between the performance with the power transformer firmly screwed to the case (in the 'transit' position) and that with it compliantly decoupled. But there *was* a noticeable difference between the figures obtained when the digital output circuitry was enabled and disabled - to the tune of about 9dB. So the ability to turn off this circuitry is certainly a worthwhile feature.

Phase linearity appeared to be excellent, with only the slightest relative error discernable between the channels, at either 0dB or -20dB.

Square wave response was also very clean, with only a small degree (around 10% p-p) of *well damped* post- and preringing visible on the square wave at lower frequencies. The same basic transient performance is evident at the higher frequencies, although the effect upon the waveform always appears more drastic due to the shorter signal period and the smaller number of harmonics present (due to the 20kHz band limiting).

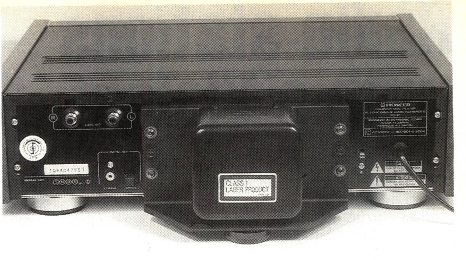
Similarly the reproduction of tone

bursts was again very clean indeed, with no discernable distortion at 400Hz, 1kHz or 4kHz.

When it came to tracking ability, the PD-91 also gave a very impressive account of itself. In fact it played every track on the Philips 5A disc without the faintest sign of distress – causing me again to check the disc label, in case I'd put in the flawless reference disc number 5, by mistake! So obviously both the tracking and error correction circuitry of the PD-91 are unphased by surface interruptions of up to 900um, 'black dots' of up to 800um or simulated fingerprints.

The only thing I did notice was that the player was fairly sensitive to vibration and quite modest jarring – particularly in the vertical direction. Not that this is likely to be terribly important, in the majority of listening situations.

All in all, the measured performance of the player was of a very high order indeed – even for a current-generation model. In fact our basic reaction, after having carried out the tests, was that the PD-91 must be capable of achieving pretty close to the maximum performance obtainable from the CD system, at least from the measurement point of view.



The view from the rear, showing the large shielded 'outboard' power transformer mounted compliantly, and the multiple outputs.

Our listening tests certainly confirmed this impression. The performance was uniformly clean, balanced and transparent, on all of our familiar 'reference' discs – covering solo and ensemble vocal, various instrumental and orchestral works. And given a disc with an inherently low noise level, the overall dynamic range was simply *dramatic.*

In short, then, the Pioneer PD-91 is indeed an excellent CD player. There's also no doubt that it belongs in the elite 'first rank' of current high-tech players, and is eminently worthy of the *Reference Series* label.

Quoted recommended retail price for the PD-91 is $1999. You should be able to hear and see it at your nearest Pioneer dealer, but in case of problems further details are available from Pioneer Electronics Australia, at PO Box 295, Mordialloc, Victoria 3195. (J.R.)

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Radio stations with a Vision

Tune just beyond the top end of the AM broadcast band, in cities such as Sydney and Melbourne, and you'll find signals from community broadcasters most of us have never heard of. Staffed almost completely by dedicated teams of volunteers, these stations provide a valuable service for the print handicapped.

by THOMAS E. KING

While mogul-manipulated Australian television stations battle for audience acceptance, with budget-breaking mini series and the nation's metropolitan commercial radio stations attempt to gain listener loyalty by offering 'big ticket' prizes, a very small number of broadcasters have attracted a faithful following with a no-frills information-orientated approach. And it's happened with such little fanfare that few listeners beyond a vast but specific target audience that spans Australia are even aware of the specialised radio service.

What makes the success of these few quiet broadcasting achievers even more surprising is that the stations are virtually staffed by volunteers, and that the faithful following are print handicapped.

The term 'print handicapped' refers to a much wider group of people than just the blind, although the visually impaired do constitute a major share of print handicapped radio audiences.

There are approximately two million people who cannot easily see, handle or understand printed material in Australia. Among these are:

- the blind and visually impaired
- people who have had a stroke
- individuals who are severely afflicted by arthritis
- sufferers of multiple schlerosis, cerebral palsy and other crippling diseases
- paraplegic and quadriplegic victims
- those with dyslexia
- the intellectually handicapped, and
- people from a non-English speaking background who can understand spoken English but not read printed material.

Just five full-time radio stations serve this diverse group of people, although two more outlets currently using shared radio facilities are anticipated to be on the air for more hours later this year, with the acquisition of their own transmitters.

Hobart's 7RPH (Radio Print Handicapped) went to air in early 1983. This was followed by 2RPH Sydney in April 1983 and later 3RPH Melbourne (where the city's 3-1/2 year old station is sponsored by the Association for the blind), 1PHR – now 1PPP – in Canberra and 4RPH Brisbane. Perth's Information Radio and a station in Adelaide assisted by the University are due to extend program time shortly, when transmitting equipment becomes available.

All 'radio print handicapped' stations currently operate under special licence on 1620 or 1629kHz – just beyond th upper edge of the main AM band, wit a maximum power of 500 watts.

Both the Canberra and Hobart stations are expecting a shift to the F band in 1989. And Sydney hopes tha authorisation to change frequency to th middle of the AM band is approved thi year.

Such a frequency move for 2RPH would be one minor technical point in a series of events which began around 1977, when a sightless woman approached Professor Neil Runcie (a Sydney-based advocate of the public radio service) with the idea of a station for the visually impaired.

A co-operative located at Sydney's Paddington Town Hall was formed to set up the station in 1979. An initial grant of $28,000 was made by the Federal Government in 1981-82. This money – allocated in the International Year of the Disabled – went for the purchase of a 500 watt Harris transmitter.

One of Station Manager Jan Marchant's many duties is fund raising; pausing next to time cards for volunteers, she displays one of the station's best sellers.

Planning the day's programming at 2RPH are, from left: Glen Barwick, Production Manager; Jan Marchant, Station Manager and Robbie Keough, a volunteer reader.

Jan Marchant has been with 2RPH since its first week of operation, in mid April 1983. With an interest in public speaking obtained through the Toastmistress organisation, she started as a volunteer reader, progressed to announcing and panel operating and into pre-recording programs.

Today, as Station Manager, she is the only paid employee although "a small honorarium could hardly be called a salary!" One of her main duties is to coordinate an energetic group of 400 volunteer readers.

Backbone of volunteers

Robbie Keough typifies the spirit of this dedicated corps of 'vollies', as they are commonly known. A friend introduced her to 2RPH at a fete, where the station had set up a fund-raising booth. Like all other potential volunteers she was required to undergo an audition.

"I certainly enjoy my hours with 2RPH", said Ms Keough, "as I am part of a massive team which is able to help listeners in a way not really offered by the commercial radio system. Knowing that, the adrenalin really runs whenever I come on air, even though I've been with the station for almost 18 months."

Apart from a personal sense of satisfaction, volunteers, in general, find that their comprehension and reading skill improves. Vollies do receive training, although it's obviously not in a structured classroom situation.

As print handicapped stations are located in major population centres and are constantly in need of dedicated personnel, budding radio announcers could learn by doing and provide a valuable service at the same time, by offering a few hours of their time each week for voluntary radio service.

"Even though we now have over 400 volunteers we are always looking for more", said Mrs Marchant. "We particularly need more male voices", she said, noting that from time to time the station does get known actors "who want to keep their voices in condition".

Like other community service broadcasters, the station is also in need of voluntary technical assistance. Involvement is required for technical work on studio equipment at 186 Blues Point Road, North Sydney or maintenance of the transmitter – which is located in Concord West, in western Sydney.

Funds for even the part-time employment of the senior technician are not available. Virtual subsistence funding from the Department of Family and Community Services covers only the most necessary operating costs. In 1989 the grant is but $41,000, and avenues for obtaining additional revenue are limited.

By law, conventional commercial advertising is not allowed. Sponsorship is permitted, but no more than four 40-word announcements may be aired in any given hour. These have to be quite subtle, and totally without the 'go to shop X and buy product Y' hard sell approach.

During the recent election period in Sydney some of the state government departments aired political announcements. "At other times", noted Mrs Marchant, "we are able to get some paid announcements, but generating additional revenue beyond our grant is difficult".

Helping supplement the yearly grant and the station's small revenue from

Glen Barwick, 2RPH Production Manager, is one of 400 volunteers who donate their talents to help some 400,000 print-handicapped listeners.

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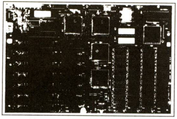

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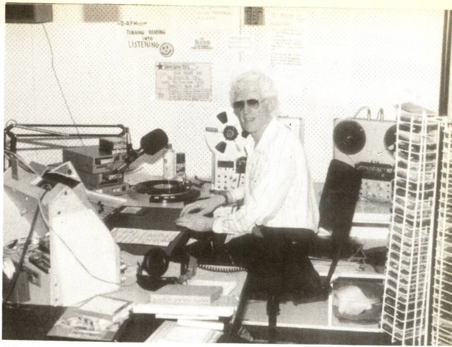


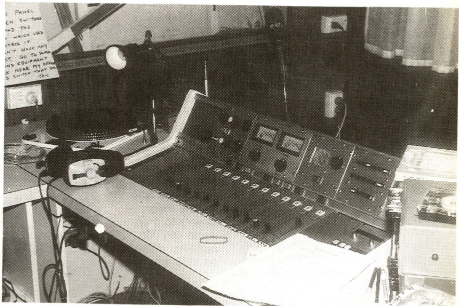
With few of the facilities of a commercial radio station, 2RPH serves a large audience of print handicapped Sydneysiders.

sponsorship is a variety of fund raising activities, which range from 2RPH emblazoned tee shirts to lapel buttons and subcription money received from RPH co-op members.

Co-op members pay $2 to join and $5 per annum, to recieve a regular program guide and the right to vote on matters relating to station policy and operation. Donations are fully tax deductable.

Very rigid guidelines also apply to other areas of community service station operation. "2RPH and the other similar outlets are not", Mrs Marchant emphasised, "so-called 'open access' stations where community groups can air their own programming". These special broadcasting stations are licensed only to provide services to the print handicapped, and are not intended to be entertainment or music orientated broadcasters. Lengthy musical pieces are rarely heard; instead short musical bridges are placed between program segments.

RPH stations are also autonomous. In addition they do not broadcast their own editorials. 'Newspapers and magazines are presented by trained volun-



The auxiliary control room is used primarily for pre-recording programs, for later airing over Sydney's sole radio station for the print handicapped.

teers, without journalistic comment or bias of any kind; the only restrictions are limitations on time', notes a 2RPH promotional piece. Every effort is made to present evenly balanced selections of material, where there is any differing point of view.

Information orientated

The editorial material of newspapers and magazines, plus books and newsletters form the basis for most programming at radio print handicapped stations. Every day dozens of publications – most of which are freely given by publishing companies – are scanned by volunteer readers who look for relevant material for later broadcasts. Depending upon a particular station's operation, readers generally cut the publications for stories and features, mark them as required for broadcast and then assemble them for reading during a particular segment.

Material is not selected for an audience that has a disability of one form or another. Rather it is selected to appeal to intelligent listeners who have interest in many fields. Programming material is drawn from a diverse field of publications.

In Sydney the 2RPH Monday to Friday broadcasting day begins at 6am, with a selection of features and columns from the previous day's papers. Until signoff at 11.30pm (1.30am on Fridays) a print handicapped audience which is estimated at around the 400,000 mark can tune into dozens of formatted programs. These include selections from the daily Sydney papers as well as the *Australian* and *Financial Review*. Coverage is given to front page and local, national and international news plus sports and/or finance.

Serialised books are broadcast almost daily, as are short stories and selected articles from leading magazines – from the *Bulletin* and *Women's Weekly* to the British *Guardian Weekly* and *Australasian Post*. Highlights of the day's TV programs are broadcast, as are news items from the suburban press and specialised newsletters for the blind and disabled.

Weekend broadcasting hours from Sydney's 2RPH are only slightly shorter (7am to 11pm Saturdays and 8am to 11pm Sundays). The bulky weekend papers provide much material for general interest reading on these days, although there are a number of specialised programs. These include a shopping guide from weekly newspaper advertisements and letter box brochures, theatre reviews and community activities, gardening and investment and/or finance segments, the armchair traveller, a junior journal for young print handicapped listeners, news from churches, a review of the world's English language presses, selections from the *Pacific Islands Monthly* and *Australian Geographic* and even a 15 minute shortwave report. Hosted by Patrick McDonald, this program is designed to provide a survey of what's on the shortwave bands.

While the information provided in this and all other 2RPH programmes is for an identifiable audience within a major metropolitan centre, freak propagation conditions occasionally occur. Because 2RPH transmits just beyond the conventional medium wave band, shortwave-like skip conditions have (rarely) sent signals from Sydney's most unusual radio station to a number of surprised overseas listeners.

"Never in our wildest dreams did we ever expect to receive letters reporting reception in Japan and Utah", said Mrs Marchant, "but it makes us happy to know that we have been of benefit to yet another specialised group of people."

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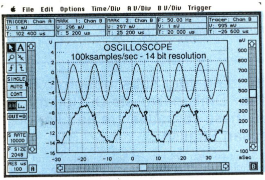

TRIGGER: Chan A
V: 1 mV
T: 102 400 us

MARK 1: Chan B
V: 296 mV
T: 5 200 us

MARK 2: Chan B
V: 297 mV
T: 25 200 us

F: 50.00 Hz
V: 1 mV
T: 20 000 us

Tracer: Chan B
V: 995 mV
T: -26 600 us

S RATE 10000
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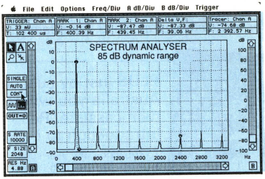

TRIGGER: Chan A
V: 33 mV
T: 102 400 us

MARK 1: Chan A
V: -0.14 dB
F: 400.39 Hz

MARK 2: Chan A
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F: 439.45 Hz

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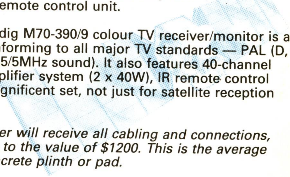
All you have to do to be in the draw to win this incredible prize is subscribe NOW, or renew/extend your existing subscription to ELECTRONICS AUSTRALIA, before June 30, 1989.

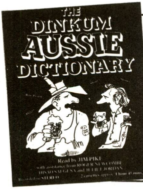
THE DISH: A top-quality 3.7 metre diameter SCI gelcoated fibreglass reinforced polyster (FRP) antenna, with a gain of 41dB at 4.0GHz. Mounted on a very rigid solid steel pedestal, via a fully lockable azimuth/elevation mount and fitted with a sturdy tripod-type feed mounting at the prime focus. Mounted at the prime focus is a California Amplifier 'Slimline' low noise amplifier (LNA), providing 48dB minimum gain at a noise temperature of 85K or lower at 25°C. This feeds the amplified satellite signals to a Drake model BDC24 low noise figure (12dB maximum) block down-converter, which shifts their frequencies down to the 950-1450MHz satellite IF band.

THE SATELLITE RECEIVER: The Grundig STR 201-Plus Satellite TV Receiver Unit is a state-of-the-art receiver tuning the full 950-1750MHz satellite IF band. It has 49 memory channels, each of which can be programmed in terms of channel deviation (25 or 16MHz), IF bandwidth, sound subcarrier frequency selection (between 5 and 8MHz) and sound de-emphasis. The receiver produces both high-quality video and audio, for feeding to a multi-standard TV or monitor, and baseband output for a D2 MAC decoder, stereo decoder or descrambler. It also features switchable video de-emphasis (PAL/D2 MAC). 2 Euro AV sockets and one DIN AV socket, and an IR remote control unit.



THE MULTI-STANDARD CTV RECEIVER/MONITOR: The Grundig M70-390/9 colour TV receiver/monitor is a luxury 28" multi-standard set capable of receiving signals conforming to all major TV standards — PAL (D, I, BG), SECAM (BG, L. DK) and NTSC (3.58/4.43MHz colour, 4.5/5MHz sound). It also features 40-channel programmable digital tuning, stereo sound decoding and amplifier system (2 x 40W), IR remote control and two Euro AV sockets for satellite receiver and VCR. A magnificent set, not just for satellite reception but for local viewing as well!

** Together with the above major components, the lucky winner will receive all cabling and connections, plus a free installation of the antenna system within Australia to the value of $1200. This is the average price for installation of an SCI 3.7m antenna system, on a concrete plinth or pad.*



PLUS just by subscribing or extending your subscription to Electronics Australia you will receive free the "Dinkum Aussie Dictionary" in a twin cassette. Read by Jim Pike, these cassettes are an hilarious introduction to colloquial Australian English.

To subscribe one year subscription (12 issues) $45, two year (24 issues) $88. Simply fill out the coupon attached and put it in the reply paid envelope supplied — if the coupon and envelope are missing, send your name, address, phone number and cheque, money order or credit card details (card type, card number, expiry date and signature) to Freepost No 4, Electronics Australia SCI Subs Offer, Federal Publishing Company, PO Box 227, Waterloo, NSW 2017. Any enquiries phone (02) 693-6666. Unsigned orders cannot be accepted.

TOTAL VALUE OF THIS PRIZE IS OVER $11,500!

But hurry — this offer closes 30th June, 1989

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HARDWARE ON DISH PICTURED IS NOT ACTUAL PRIZE. FOR FURTHER INFORMATION ON S.C.I. PRODUCTS CALL WENDY GILBERT-GREY ON (02) 317-5911.

Conditions of entry.

1. The competition is open to Australian residents authorising a new/renewal subscription before last mail June 30, 1989. Entries received after closing date will not be included. Employees of the Federal Publishing Company, SCI and Southern Cross Electronics Pty Ltd and their families are not eligible to enter. To be valid for drawing, subscription must be signed against a nominated valid credit card, or if paid by cheque, cleared by payment.
2. South Australian residents need not purchase a subscription to enter, but may enter only once by submitting their name, address and a hand-drawn facsimile of the subscription coupon to The Federal Publishing Company, PO Box 227, Waterloo, NSW 2017.
3. Prizes are not transferrable or exchangeable and may not be converted to cash.
4. The judges decision is final and no correspondence will be entered into.
5. Description of the competition and instructions on how to enter form part of the competition conditions.
6. The competition commences on 28th February, 1989 and closes with last mail on Jun 30, 1989. The draw will take place in Sydney on July 3, 1989, and the winner will be notified by telephone and letter. The winner will also be announced in The Australian on July 7, 1989 and a later issue of this magazine.
7. The prize is a Satcom II Midrange System consisting of 3.7 metre dish antenna with mounting pedestal and AZ/EL mount, feedhorn, low-noise amplifier and block down-converter, a Grundig STR 201 Plus Satellite TV Receiver/Monitor, plus all necessary cables and connectors, and FREE installation up to the value of $1200. Prizes to be installed at a mutually agreed date within six months of winner being notified. Installation free up to $1200. (Average cost of installation.) Total value of prize including installation is $11,580.
8. The promoter is the Federal Publishing Company, 180 Bourke Road, Alexandria, NSW 2015. Permit No TC89/0000 issued under the Lotteries and Art Unions Act 1901: Raffles and Bingo Permit No 890000 issued on 00/00/89 ACT Permit No TP890000 issued under the Lotteries Ordinance 1964.

TV RECEIVING SYSTEM

Silicon Valley NEWSLETTER . . .

AMD sells Manilla operation

Less than 10 years ago, just about every major US semiconductor manufacturer depended on The Philippines for a large portion of their assembly operations. Today, only a few remain. Recently, Advanced Micro Devices became the latest to pull out of The Philippines, with the sale of its Manilla-based facilities to Amkor Electronics.

Under the terms of the deal, AMD will continue to contract with Amkor for the assembly of components. But the move is part of an overall move of its assembly operations to a new fully automated facility in Bangkok, Thailand.

Amkor has agreed to retain all 1,500 AMD workers at the four-building 183,000 square-foot assembly facility, without reduction in pay or change in benefits.

According to AMD president Tony Holbrook, the sale to Amkor is an important step to bringing the new Bangkok facility into operation. "Ramping up production at this 157,000 square-foot state-of-the-art assembly facility is a major undertaking. The agreement with Amkor will enable AMD to continue to have a reliable source for manufacturing while we facilitate operations at our new plant in Bangkok.

IBM exec warns US must improve manufacturing

If the United States does not improve its manufacturing capabilities in the near future, the nation's industry is unlikely to be able to compete effectively on a worldwide basis, according to one of IBM's highest ranking executives.

"If we cannot compete in manufacturing, we can't grow as a nation," warned Jack Kuehler, vice chairman of IBM. And if the US cannot provide enough people with adequate technical and scientific skills, he added, "the game will be all over".

Keuhler, who spoke before a group of 200 Silicon Valley business leaders, said the US share of various world markets has plunged since the early 1970s. In machine tools, for example, the US controlled 100% of the machine tool market. Today, that has been reduced to 35%. In telephones, the US share has fallen from 90 to 25% and in colour TVs from 90% to less than 1%.

"The basic reason for those dramatic declines is that the US industries in these and many other sectors were simply out-manufactured, not only in Japan, but also by other countries in Asia and Europe. Since 1980, European productivity gains have been double those in the US. And in the same period, Japan's increase outstripped us six to one," Kuehler said.

To reverse the trend, Kuehler urged that US comapnies and universities start treating manufacturing with the respect it deserves. "What really lies behind the thing we have called the 'Japanese miracle' is actually Japan's genius for managing manufacturing, focusing corporate attention on it and investing in the production process."

Apple suing Apple in logo battle

In what may become the next most closely watched legal battle in Silicon Valley, Apple Records, the record label started by the Beatles in the late sixties, announced it has filed a trademark infringement lawsuit against Apple Computer. In the suit, Apple Records is asking the court to force the Cupertino computer maker to both change its logo and pay more than US$200 million in damages.

The lawsuit, which was filed on behalf of the Fab Four in London, claims that Apple Computer has violated an – until now – secret agreement under which Apple was allowed to continue to use the apple symbol in its logo.

According to the suit, Apple is violating that agreement because the company's Apple IIgs and Macintosh computers are now also marketed as music instruments and synthesisers. "If they want to continue making music synthesisers, our position is that they can change their name to Peach or Banana. That wouldn't bother the Beatles," said Wayne Cooper, who represents Apple Records in the suit.

According to Cooper, the three surviving members of the group, Pau McCartney, George Harrison and Ringo Starr are taking a "very personal interest" in the case.

At Apple Computer, company spokeswoman Carleen Le Vasseur said Apple had not had a chance to study the lawsuit and would not comment on the case. "The only thing I can tell you is that we don't believe that we have broken the 1981 agreement."

For his part, Cooper said the record company had tried to work out a "reasonable arrangement" with Apple to compensate the record company in the form of royalty payments. "It is unfortunate that we couldn't have worked this out in an agreeable way. But that is not the fault of the Beatles".

Under the terms of the 1981 agreement, Apple Computer paid Apple Records an undisclosed amount for the right to continue to use the multi-colour apple in its logo. The agreement also retained the right of the record company, which was founded 10 years before Apple was formed in 1977, to continue to use its apple-based logo in its music and apparel-related businesses. Finally, Apple agreed not to enter the music business where the two trade marks would be in conflict with each other.

Sony bids for US HDTV research grant

In a bold and surprising move, the US subsidiary of Japan's Sony announced it has bid on contracts to help the US Defense Department develop high-definition television (HDTV) technology. The move has set off a lively debate amoung US industry and government officials over the potential of US sponsorship of foreign research. Meanwhile new legislation was introduced in Congress to give US companies incentives to invest in HDTV research.

The bid from Sony was amoung several received by the Pentagon, which is planning to hand out $US30 million in funds for projects aimed at developing HDTV technology.

When the program was announced just last December, officials made it clear that the program was designed to assist US firms in developing the necessary technology to help them compete against the Japanese and Europe-based leaders in the consumer electronics markets.

Initially, the Pentagon said only US firms could apply for the grants. But in January, the Defense Department announced that in order to comply with federal procurement rules that call for fair and open competition, foreign-based firms would be allowed to bid as well.

In all, the Pentagon said it has received more than 80 proposals for the HDTV grants. Following the bid from Sony, officials said they expect to receive several more bids from European and Japanese companies.

The Sony announcement set off a storm of protest. "I would be very concerned if the government was funding research in Japanese labs and technology was flowing out-bound," commented Pat Hubbard, vice president for government relations of the powerful American Electronics Association.

Samsung agrees to make two-tape VCRs

One of the smallest US companies in the VCR business has gained a major boost in its effort to bring a dual-deck VCR to market, as one of the biggest names in the business announced it would licence the tiny firm's innovative technology.

Go-Video in Arizona said it has signed a deal with Samsung Electronics to licence Go-VIdeo's dual-VCR patent, and manufacture and market the two-tape VCR system which eliminates the need for consumers to buy or borrow a second VCR to make copies of tapes.

Samsung is the first major VCR manufacturer to agree to licence Go-Video's technology. As part of the deal, Go-Video dropped Samsung from the list of companies mentioned in the firm's anti-trust lawsuit. Sony, Matsushita, JVC, NEC and Korea Daewoo remain on that list.

According to Go-Video executives, the agreement with Samsung means the first dual-tape VCR's could be on the US market as early as this Christmas – and cost less than $1000.

Another feature of the two-tape system is that besides copying, it can also simultaneously record two different programs on different television channels. And viewers can watch a program recorded earlier on one tape, while the machine records another program on the second tape.

The decision by Samsung marks a major legal victory for Go-Video, as it had to overcome the fear of VCR makers of the powerful movie industry, which has strongly objected to the development of the dual-tape system. Even though the system will not copy movies which have been encoded to prevent copying, the movie industry fears the proliferation of dual-tape machines will seriously hurt the movie and video rental business.

Apple exec urges US government to develop ISDN

Jean-Louis Gassee, the outspoken Apple executive, told a group of 350 business executives and students that the United States government should "get off its fat butt" and start promoting and developing a US-wide digital ISDN telecommunications network, or risk becoming a "third-world nation" in terms of computer networks.

The existing network of analog-based telecommunications networks will not be capable of handling the kinds of data that needs to be transmitted in the business environment of the near future. In this environment networks have to be able to simultaneously transmit data, video, and voice.

Although a standard for such transmission, the Integrated System Digital Network (ISDN) has been established for some time, progress in implementing the technology has been agonisingly slow. On the other hand the technology and products to take advantage of ISDN have already begun to arrive.

In Europe and Japan, implementation of ISDN networks is advancing at a much greater pace than in the US. "If a Japanese office worker has better tools than a clerk in the United States, we are going to contine our downward slide," Gassee said.

Defence contractor's move shocks valley

Silicon Valley is getting too expensive an area to do business, according to one of the area's leading defence electronics contractors – which announced it is moving more than a third of its workforce 50 miles to the East.

ESL of Sunnyvale said it is transferring some 1000 of its 2800 highly skilled engineering jobs to Livermore, an area that features affordable housing, rarely congested roads, and plenty of skilled labor as the city is the site of the Lawrence Livermore Laboratory, one of the premiere sites for the development of new nuclear weapons systems.

"The cost of housing around here (Silicon Valley) is absurd and the traffic situation is getting increasingly difficult. Silicon Valley is getting to be an expensive place to do business," said ESL president Robert Kohler.

Ironically, Kohler currently serves as the president of the Santa Clara County Manufacturers Group, a group that is supposed to stimulate the county's business climate.

The move symbolises the difficulties local government has experienced in dealing with the explosive growth of the area's industry during the 1980s and in providing adequate housing and transportation for the area's workforce.

Kohler said ESL would retain its corporate headquarters in Sunnyvale. But it is planning to vacate 6 of its 18 facilities in the area, idling some 230,000 square feet of office and manufacturing space.

AT&T and Zenith team up in HDTV venture

AT&T, America's largest communications firm, and Zenith, the only remaining US manufacturer of television sets announced they have reached agreement on a joint venture aimed at developing and marketing the next generation of high-definition television receivers for which a US$50 billion market is expected in the USA alone by the year 2000.

Perhaps most important in the announcement was the determination by both firms to co-operate, not just on the development of a HDTV receiver but on the development of an entire HDTV transmission system built around Zenith's 'spectrum' compatible HDTV system.

The two firms said they had submitted their proposals to the Pentagon, which is taking a key interest in the development of a US HDTV industry and has offered to co-finance research projects that would examine the use of HDTV for a wide range of military applications.

Initially, AT&T and Zenith plan to spend US$24 million on the first phase of their HDTV development project, US$13 million of which they hope to receive from the Pentagon.

With the announcement, AT&T and Zenith have become the first of a number of companies and alliances that hope to take advantage of the huge market opportunity that is expected to be created by HDTVs in the mid-to-late 1990s.

The 'Dream' computer – ten years on...

In May 1979, we published the design for a small educational microcomputer called the Dream 6800. It proved to be extremely popular, with many thousands built by eager computer enthusiasts. A few weeks ago some of those enthusiasts gathered in Tasmania, to celebrate the Dream's 10th birthday.

by TOM MOFFAT

Do you remember the Dream? Longtime readers of *Electronics Australia* may remember it, but I'll bet there are some readers out there who weren't even born when the Dream came on the scene. The Dream was a little homebuilt computer kit that took Australia by storm when it was described on these pages just ten years ago last month.

'Designed especially for beginners! Dream 6800! Talks directly to your TV and is programmed in a high-level language!' Those were the headlines screaming from that first article in May, 1979. That was enough for me, I was hooked. I was on the phone to Applied Technology that afternoon – yes, they could send one right away – after they cleared my cheque of course. Not many people did business by Bankcard in those days.

When the Dream computer eventually turned up (it seemed like ages, but was only a few days), I took over the dining room table for what was virtually a nonstop session of kit building. There was one major circuit board, single-sided only, and as I remember it had well over 100 wire jumpers to do what double-sided boards do today.

Then came resistors, capacitors, some other chips, and finally something I'd never seen before – a microprocessor! I treated that thing as if it were made of gold, but today you can buy one like it (a Motorola 6802) for two or three dollars.

To many of us in electronics ten years ago, computers were a foreign and slightly useless idea; something to be ignored and avoided. This was mostly because of fear. We didn't understand them, and didn't want to.

Electronics Australia had described an earlier computer, called the 'EDUC-8' as I remember, and I refused to even read the articles. I will now admit that I didn't understand the articles, but I didn't want to admit it, even to myself. So I just didn't read them. That machine was a big box with flashing lights and switches that meant something to someone, but not me!

The Dream didn't seem so threatening. Perhaps it was the word 'beginners' in the headline. The article didn't show a picture of a big mean box. There was a TV set, and a circuit board under a plastic sheet, and a smiling girl pressing some buttons (not switches!). On the screen were all sorts of little spots of light, and under it a number – 3333.

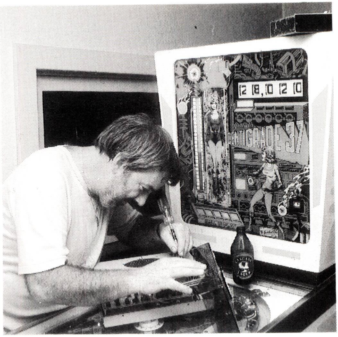
It looked pretty innocent then, but now, after many years experience with the Dream, I can reveal all. I think that Dream had just crashed. That's what mine looked like when it crashed – a performance it put on every few minutes when I was trying to program it!

The afternoon I finished building my Dream kit I was supposed to go to a barbecue at the home of a long-time friend, another electronics freak and a radio ham. As my family shuffled their feet and cast dirty looks my way, I rushed to connect the last wires and give the Dream the smoke test. Whacko! It worked first time. I typed in a little program, and that worked too, so I tossed it all in the box and headed off for the barbecue, computer in hand.

I intended to dazzle this fellow's brain right out of sight with my new electronic marvel. In his kitchen I hooked the Dream's video up to his TV set and played in a cassette of the shoot-em-up game I'd previously typed in. This was a very, very early version of Space Invaders, where you blasted rockets at things moving across the top of the

Hip-hip-hooray! Three cheers for the Dream — even if neither sample of the Dreams brought to the party decided to work!

Frank Weston applying a 'technical tap' to try and make his Dream's monitor work. It didn't.



Frank still trying to fix his Dream's video. The workbench is the Hobart Microbee User Group's much-loved pinball machine.

screen.

Amazing it was, but my friend's reaction was "So what?". He didn't appear to be among the converted, no 'hacker potential' at all. It was the same with my family, and remains so to this very day when I do something stunning with a computer – "So what?"

It seems there were many other people around Hobart suffering from the 'so what' effect, so we quickly became known to each other. Face to face meetings and computer demonstrations produced a much more satisfying response among the converted, so we saw more and more of each other.

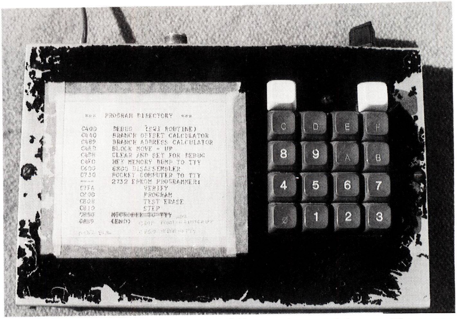
The original Dream project started growing. As soon as we figured out what 'RAM' was (memory), we decided we needed more than the 1K that came with the machine – so we expanded it. This same 'not enough RAM' disease is rife among computer users to this very day. And the ROM, the memory containing the computer's inbuilt instructions, had to be expanded too.

I built my own Dream into a specially made metal case. It took hours and hours of panel beating to get that case right, but it was strong when it was completed. This is good, because that computer has had so much use that much of the paint has worn off the case. There's still a piece of paper, taped onto it, showing the run addresses of all the home-made software.

I spent a lot of time learning to program that silly machine, but it started me off on a career path that's still paying dividends. Most of my own projects were machine code utilities, for directly fiddling about with memory and manipulating the microprocessor. I built an EPROM programmer, and put most of these little routines into my expanded version of permanent ROM memory. Some commercial companies released enhanced versions of ROMs as well.

My Dream even had its own weekly segment on commercial television, for a while. I had written a program to make it select random numbers for Soccer Pools tickets. This was accompanied by an animated display of a little fellow kicking a soccer ball across the bottom of the screen, as each number was selected.

The Soccer Pools people heard about the number selector program and commissioned the Dream to do its tricks on TV, selecting numbers for the punters who thought the computer would give them an advantage. Its video output was stable enough to feed straight into a



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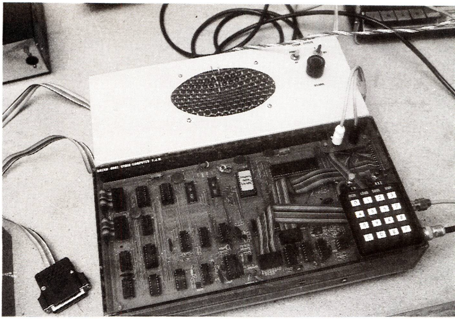
C4AD BLOCK MOVE - UP
C4D8 CLEAR AND SET FOR DEBUG
C4F0 HEX MEMORY DUMP TO TTY
C600 6800 DISASSEMBLER
C730 POCKET COMPUTER TO TTY
---- 2732 EPROM PROGRAMMER:
C7FA VERIFY
C800 PROGRAM
C808 TEST ERASE
C810 STEP
~~MICROBEE TO TTY~~
(END)

Tom Moffat's own somewhat battered Dream, in a metal case. The paper 'panel' lists firmware program addresses.



A nicely built Dream kit with enhanced memory and commercially upgraded operating system ROM.

studio mixer, where the director then added colours to the numbers, the little man, and the background. It all looked quite flash, especially when you realize it was coming from a hobbyist's 'black box'. Trouble is, the Dream's pools numbers never seemed to do much good; not for me at least!

A couple of years after the Dream kit's introduction, its makers, Applied Technology, released another kit, the Microbee. The machine was a big step up; it had a real keyboard, and it ran BASIC. Many Dream owners again took the plunge, and we were soon getting together even more often to try to impress each other with our computer prowess. This arrangement was eventually formalised into the Hobart Microbee User's Group.

Even though the Microbee project has now fizzled out a bit, the group still meets once a month, although there are now more IBM's and Amiga's than Microbees. In fact a couple of months ago, for the first time ever, the Microbee group met without one Microbee being there.

Oh well – who needs computers, anyhow? The best arcade game in the whole place is an elderly electro-mechanical pinball machine, and every meeting is punctuated by thunks, clangs, dings, and the joyous shouts of the pinball players.

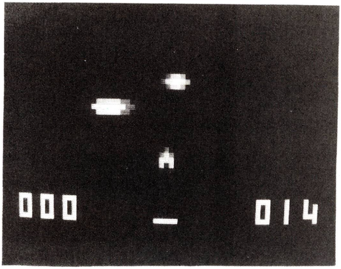
When the Microbee group saw that the Dream's tenth birthday was coming around, a 'Dream night' was scheduled. Time to get back to our roots. The group's leader, Frank Weston, brought his Dream along; I brought mine along. Just like in the early days we were going to amaze and astound the other members of the group.

But, despite tests earlier that day, Frank's blasted Dream wouldn't work! No video. Frank reacted in the traditional manner and administered a mighty belt to the monitor, but still nothing. His Dream was supposed to come up and display 'HELLO FRANK' on the screen. What a dud!

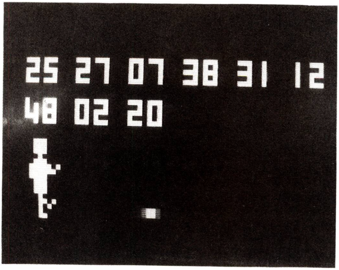
My Dream wouldn't work either; I'd neglected to bring the power supply. Not to worry, the Dreams were there in spirit – so just for them, we threw a birthday party. (Any old excuse to crack a few stubbies!) This went on well into the night, with much good cheer offered for the future health and wellbeing of the Dream computer. And of course, much clanging and thumping from the pinball machine.

The next day, all bleary eyed as expected, I decided to fire up my own Dream, just for old time's sake. And believe it or not, It wouldn't go. No video – the inner lead of the cable was broken.

What gives? Are these machines going on strike or something? Or have they just decided to retire? Fair enough, I suppose they've had a pretty good run. But who knows? Eleven years hence, when they turn 21, they may just face another party!



A Dream computer screen display of UFO-INTERCEPT – an early shoot-em-up game. Not exactly hi-res graphics!



Tom Moffat's Dream computer display of a soccer pools number selector, as used on commercial TV.

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- 6/10 MHz system clock with zero wait state. 12 MHz, 1 wait state
- 80286-10 Microprocessor
- Hardware and software switchable
- Socket for 80287 numeric data co-processor
- 64K ROM
- Phoenix BIOS
- 8 Expansion slots

Excluding Ram
X18200....................$689
Including 2M/Byte Ram
X18201..................$1,649

386 MAIN BOARD

- Intel 80386 CPU (20 MHz)
- Socket for 80387 Math co-processor
- 32 bit BUS system, 1 M/Byte or 640K on board memory
- Built-in speaker attachment
- Battery backup for CMOS configuration table and real time clock
- Keyboard controller and attachment
- 7 Channel DMA
- 16 Level interrupts
- 3 Programmable timers
- 8 System expansion I/O slots: 5 with a 36 pin and a 62 pin expansion slots / 2 with only the 62 pin expansion slot / 1 with two 62 pin expansion slots (32 bit BUS)

Without RAM
X18103..................$2,390
Including 2 M/Byte RAM
X18107..................$3,500

386 CACHE 25MHz MOTHERBOARD

X18105..................$4,395

VIDEO CARDS

VGA CARD

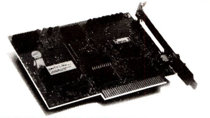
- PC*/ XT*/ AT* compatible
- 512K RAM
- Hardware zoom, pan, window

X18072....................$825

VGA CARD

- PC*/ XT*/ AT* compatible
- 245K RAM
- Excellent Value
- Works with OS/2

X18071....................$655



POSTCARD DIAGNOSTIC MODULE

Pinpointing component problems in IBM* compatible motherboards can take hours. Usually the whole system has to be working to isolate the troubled area. But not so with the new Postcard Diagnostic Module. So no other cards are necessary to test a bare motherboard.
"It now only takes seconds."

Simplified debugging for:

- Field service- for on-site repairs or maintenance depot work
- Manufacturing test- for burn in test flaws and to do quality control
- Inspection- Postcard simplifies incoming and outgoing test processes on stand

X18048..................$849

KEYBOARD & ACCESSORIES

MINI VACUUM CLEANER

Use it to clean:

- Computer keyboards
- Printers
- Video recorders
- Computer circuit boards

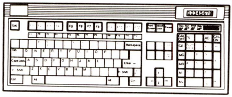
C21087................$14.95

MAGIC STAGE

A working bench for your Mouse.

- High quality ABS plastic and anti-static rubberised top
- Stationary holder
- Includes pull-out shelf for Mouse
- Dimensions: 280 x 260 x 25mm
- Fits over keyboard

C21080................$24.95

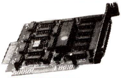


KEYBOARD WITH SOLAR CALCULATOR

- Enhanced RT layout plus calculator function keys
- Size: 495 x 195mm (W x D)
- Custom mold logo tab
- FK-3002, 112 keys European version
- Big-caps calculator function Japan Alps Mechanical tactile"Click" keys

X12024............$189.9

DISK DRIVE CARDS



FLOPPY DISK DRIVE CONTROLLER CARD

These cards will control up to 2 or 4 double sided 360K IBM* compatible disk drives.

With 2 Drives
X18005......................$52

HARD DISK CONTROLLER CARDS

X18060 (XT*)............$190
X18140 (AT*)............$290

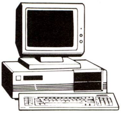
FLOPPY DISK DRIVE CONTROLLER CARD

- Supports 1.44MB, 1.2MB, 720K, 360K
- PC*/ XT*/ AT* compatible
- 5 1/4" and 3 1/2" drives

X18009....................$139

SUPER FAST DYNAMIC RAMS

4164-150ns	$4.22
4464-150ns	$17.85
41256-80ns	$14.95
41256-100ns	$14.30
1MB-100ns	$42.20



IBM* XT* 640K RAM TURBO COMPATIBLE COMPUTER

Check these features and our prices. We're sure you'll agree they're exceptional value for money!

- Final assembling and testing in Australia!
- Fast TURBO Motherboard
- AT* style keyboard
- Tested by us for 24 hours prior to delivery!
- 8 Slot motherboard
- 12 months warranty!
- 150W power supply

640K RAM TURBO COMPATIBLE COMPUTER

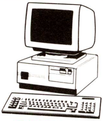
2 x 360K Disk Drives, Multi-function Card, Colour Graphics, Disk Controller, 1 Serial, Parallel Port(Clock)....................$1,195

*$995 WORKSTATION COMPATIBLE COMPUTER

256K RAM, Single Drive, Graphics and Disk Controller Card......................................$995

WITH 20 M/BYTE HARD DISK:
& single 360K Disk Drive...$1,495
& dual 360K Disk Drives...$1,695

WITH 40 M/BYTE HARD DISK:
& single 360K V.C. H.D......$2,095
& dual 360K V.C. H.D.........$2,295



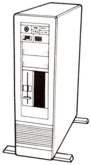
BABY AT* COMPATIBLE COMPUTER!

2M/B RAM $2,695

- Final assembling and testing in Australia!
- 4 M/Byte Main Board, 2 M/Byte fitted
- Switchable 8/10/12 MHz
- 1.2 M/Byte Floppy Disk Drive
- 80286 CPU
- Colour Graphics Display Card
- 8 Slots
- Floppy & Hard Disk Controller
- Printer Card and RS232
- Keyboard
- 200W Power Supply
- Manual
- 6 Months Warranty
- Size: 360(W) x 175(H) x 405(D)mm

With 20 M/Byte Hard Disk.$2,695
With 40 M/Byte V.C. H.D....$3,295
With 80 M/Byte Hard Disk..CALL

◀ COMPUTE & ACCESSORI

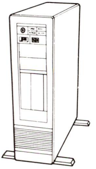


386 TOWER PC

The 386 Tower PC is a high performance system that's I AT* compatible. However, th 386 Tower PC gives you 2-5 times the performance.
FEATURES:

- Intel 80386-16MHz microprocessor
- Switchable 16/20 MHz
- 2 M/Byte fitted. Total memo expandable up to 16 M/Byte
- Up to 2 M/Byte or 8 M/Byte RAM modules on system board or on RAM card
- Option for 80287 & 80387 co processor socket
- Operates in page mode with interleave memory subsyste
- Shadow RAM supported to allow system BIOS to be executed on system memor instead of slower EPROM
- Four 16-bit I/O slot. Three 8- I/O slot, and one 32-bit mem slot
- 8042 keyboard controller interface for AT* compatible keyboard
- Seven direct memory acces (DMA) channels
- Chips and Technology chip
- AMI 386 BIOS/ Phoenix 386 BIOS/ AWARD 386 BIOS (AM fitted)
- 50 M/Byte hard disk. 42 M/By formatted. Fast access
- EGA card
- 3 1/2" drive 1.44 M/Byte

X20070..................$5,99



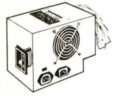
TOWER COMPUTER CASING

Remount your computer to giv it that professional look.

- Accepts XT, AT, Baby AT and 386 boards
- Horizontal full height hard dis drive mounting
- Room for 2 x3 1/2" and 2 x 5 1/4" floppy drives
- Full height HDD plus fan mount
- Size: 165(W) x 600(H) x 500(D

X11105.....................$29

OWER SUPPLIES



150W SWITCH MODE POWER SUPPLY FOR IBM* PC/ XT* & COMPATIBLES

C OUTPUT:
+5/ 13A, -5V/ 0.5A
+12V/ 4.5 - 12V/0.5A
11096.....................$129

180W SWITCH MODE POWER SUPPLY FOR BABY AT* COMPATIBLES

11098.....................$169

200W SWITCH MODE POWER SUPPLY FOR IBM* AT* & COMPATIBLE

C OUTPUT:
5/ 16A, -5V/ 0.5A
12V/5A - 12V/ 0.5A
11097.....................$199

ROD IRVING ELECTRONICS

All sales tax exempt orders and wholesale inquiries to:

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Fax (02) 519 3868

MELBOURNE: 48 A'Beckett St.
Phone (03) 663 6151

NORTHCOTE: 425 High St.
Phone (03) 489 8866

CLAYTON: 56 Renver Rd.
Phone (03) 543 7877

MAIL ORDER & CORRESPONDENCE:
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Order Hotline: 008 33 5757
(Toll free, strictly orders only)
Inquiries: (03) 543 7877
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Fax: (03) 543 2648

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(TOLL FREE)
STRICTLY ORDERS ONLY

LOCAL ORDERS & INQUIRIES
(03) 543 7877

POSTAGE RATES:

$1 – $9.99	$2.00
$10 – $24.99	$3.00
$25 – $49.99	$4.00
$50 – $99.99	$5.00
$100 plus	$7.50

The above postage rates are for basic postage only. Road Freight, bulky and fragile items will be charged at different rates.

Errors and omissions excepted. Prices and specifications subject to change.

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DISK DRIVE

QUALITY JAPANESE DRIVES

5 1/4" 360K DRIVE

- 500K unformatted
- IBM* XT* compatible

C11901.....................$239

5 1/4" 720K DRIVE

- 1 M/Byte unformatted
- IBM* AT* compatible

C11906.....................$269

APPLE* COMPATIBLE SLIMLINE DISK DRIVE

- Compatible with Apple 2+

X19901.....................$179

FREE PACK OF S/S DISKS WITH EACH DRIVE!

APPLE & IIC COMPATIBLE DISK DRIVE

Including cable.......$199

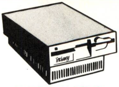
3 1/2" 1.44 M/BYTE DRIVE

- Switchable 1.44 M/Byte formatted or 720K formatted
- Double sided, Double density
- 5 1/4" mounted

C11911.....................$225

CONTROLLER CARD TO SUIT
X18009..................................$139

MOUNT WITH POWER CABLE ONLY
X11920................................$19.95



EXTERNAL PS/2* COMPATIBLE 5 1/4" DISK DRIVES

Capacity: 360K formatted
Track/Disk: 80/160
Number of Cylinders: 80
Average Access Time:
91 (94) msec
MTBF: Greater 10,000 hours
MTTR: 30 min. or less

- External 37 pin connector cable
- Internal 40 pin adaptor cable for PS/2 models
- 40 pin card edge
- Installation Guide

C11907.....................$495

HARD DISKS

20 M/BYTE HARD DISK

- Drive with controller card, IBM* compatible, 12 month warranty

X20010.............only $449

40 M/BYTE VOICE COIL HARD DISK

- IBM* compatible, 28 msec access, 12 month warranty

Without controller...$895

80 M/BYTE VOICE COIL HARD DISK

- IBM* compatible, 25 msec access, 12 month warranty

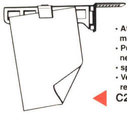
Without controller.$1,595

330 M/BYTE VOICE COIL HARD DISK

- IBM* compatible, 18 msec access, ESDI,12 month warranty

Without controller.$3,200

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★



GRIP CLIP COPY HOLDER

- Attaches to the top of your monitor
- Put your copy, right where you need it
- spring clip to hold paper
- Velcro at mount for easy removal

C21065.................$14.95

ARGUS 726 ADJUSTABLE MAGNIFIER WITH LAMP

Perfect for close up work! Intricate PCB's, projects, etc., will be a breeze under this superb, adjustable magnifying lamp.

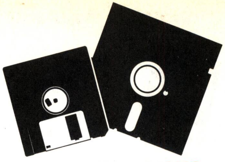
- Magnifies 1.75 times
- 40 watt incandescent lamp
- 2 spring-balanced arms, extendable to 800mm
- Adjustable head for optimum viewing
- Variety of mounts available, but not included

T10015.......................$99

ARGUS CLAMP BASE
T10016...................$9.50

ARGUS T-BASE
T10017.................$17.50

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★



"NO BRAND" DISKS

Now you can buy absolute top quality disks that are also the cheapest in Australia! They even come with a lifetime warranty, which indicates the quality of these disks. So why pay 2-3 times the price for the same quality?
Packs of 10, D/S D/D without boxes, or brand name, just their whitepaper jacket, and index label. (5 1/4" disks includes write protects)

5 1/4" 2S/2D "NO BRAND" DISKS

10+ DISKS	100+ DISKS	1,000+ DISKS
$6.50ea	$6.25ea	$6.00ea

5 1/4" HIGH DENSITY DISKS

(DOUBLE SIDED)

10+ DISKS	100+ DISKS	1,000+ DISKS
$21ea	$20ea	$19ea

3 1/2" 2S/2D "NO BRAND" DISKS

Suitable for IBM, PS/2, Macintosh, Atari, etc.
$21
(ALL PRICES PER 10 DISKS)

VERBATIM DISKS

(ALL PRICES PER BOX OF 10 DISKS)

DESCRIPTION	1-9 BOXES	10+ BOXES
3 1/2" 1S/2D	$39.95	$37.95
3 1/2" 2S/2D	$46.95	$43.95
3 1/2" 2S/HD	$99.00	$89.00
5 1/4" 1S/2D	$22.00	$21.00
5 1/4" 2S/2D	$26.00	$24.00
5 1/4" 2S/4D	$75.00	$70.00
5 1/4" 2S/HD	$41.00	$39.00

DISK BOXES

80 x 3 1/2" DISK STORAGE UNIT

- Holds up to 80 x 3 1/2" diskettes.
- Smoked plastic hinged lid
- Lockable (2 keys supplied)

C16038.........only $19.95

40 x 3 1/2" DISK STORAGE UNITS

- Holds up to 40 x 3 1/2" diskettes
- Lockable (2 keys supplied)
- High impact plastic lid and base

C16035.........only $14.95

120 x 3 1/2" DISK STORAGE UNIT

- Holds up to 120 x 3 1/2" diskettes
- Smoked plastic hinged lid
- Lockable (2 keys supplied)

C16039.........only $21.95

50 x 5 1/4" DISK STORAGE UNITS

- 50 x 5 1/4" Disk capacity
- Smoked plastic hinged lid
- Lockable (2 keys supplied)

C16025.........only $14.95

100 x 5 1/4" DISK STORAGE UNIT

- 100 x 5 1/4" disk capacity
- Smoked plastic hinged lid
- Lockable (2 keys supplied)

C16020.........only $15.95

DD 120 x 5 1/4" DISK STORAGE UNITS

- Holds up to 120 x 5 1/4" diskettes
- Lockable (2 keys supplied)
- High impact plastic lid and base

C16028.........only $19.95

ROD IRVING ELECTRONICS

GENERAL ACCESSORIES

12V DC FANS

80 x 80 x 25.4mm
12V DC, 1.7 Watt, 0.14 Amps
T12469..................$12.95
10+ fans only $11.95 each

BRAND NEW FANS

Quality, new fans for use in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air.

240V	4 5/8"	T12461	**$12.95**
115V	4 5/8"	T12463	**$12.95**
240V	3 1/2"	T12465	**$12.95**
115V	3 1/2"	T12467	**$12.95**

10+ fans (mixed) only $11.95 each

FAN GUARDS TO SUIT

4 5\8" **T12471...........$3.95**
3 1/2" **T12475...........$3.95**

BALL BEARING FANS

Quality, new ball bearing fans suitable for power amps, computers, hotspot cooling etc. Anywhere you need plentyof air!

T12464240V 4 5/8".....**$14.95**
10+ fans only $11.95 each

U.S. TELEPHONE EXTENSION CABLE

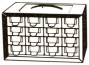
- U.S. plug to U.S. socket
- Length 10 metres

Y16024....................$7.95

U.S. TELEPHONE EXTENSION CABLE

- U.S. plug to 2 U.S. sockets
- Length 10 metres

Y16028....................$9.95



PORTABLE 16 DRAWER CABINET

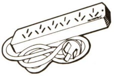
- Overall size:
  270 (L) x 160 (W) x 165 (H)mm
- Drawer size:
  142 (L) x 56 (W) x 31 (H)mm
- Metal case, clear plastic drawers
- Carry strap
- Stackable or wall mountable

H10085..................$19.95

PIEZO SIREN

- 4 piezo units in a high impact plastic cabinet
- Input 12V DC - 200mA
- Output 115dB at 1m, dual tone
- Compact size 105 x 85 x 45mm
- Smart design suits interior use

S15071..................$24.95



SURGE BUSTER

6 PROTECTED POWER OUTLETS
Ideal for protecting personal computers, video equipment, colour TVs, amplifiers, tuners, graphic equalisers, CD players etc

SPECIFICATIONS:

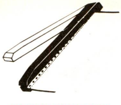
- Electrical rating: 240V AC, 50Hz, 10A
- Complies with Australian Standards. Approval No.10084
- 3 x Metal Oxide Varistors (MOV)
- Surge/ Spike Rating (each MOV): 4,500 amps (8 x20us)
- Energy Absorb. Factor each MOV: 75 joules (10 x 1000us)
- Maximum clamping Voltage: each MOV: 710 volts at 50 amps
- Response time: Less than 25 Nanoseconds.

X10086....................$69.95

THE BUTTON SPIKE PROTECTOR

Simply plug the button into an outlet and it will protect all equipment plugged into adjacent outlets on the same branch circuit.
The button employs unique metal oxide varister technology and will dissipate 150 joules of electrical energy. (nearly twice that of comparable surge arresters).

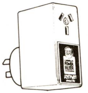
SPECIFICATIONS:
Voltage: 240V Nominal
Total Energy Rating: 150 joules
Response Time: 10ns
Protection Level: 350V peak
X10087..................$36.95



RIPPER STRIPPER

Remove ugly paper feed edges quickly and cleanly with this simple little gadget
C21085................$14.95

240V ACCESSORIES



CPF CONTINUOUS POWER FILTER (SPIKE ARRESTOR)

The fortron CPF Filtered Electronic Spike Protector provides a protective electronic barrier for microcomputers, printers, telephone systems and modems electronic typewriters, audio and stereo systems and other sensitive electronic equipment.
CPF's superior circuitry design and semiconductor technology responds instantly to any potentially damaging over-voltage, ensuring safe trouble free operation.
Additionally,CPF's filtering capability helps eliminate troublesome and annoying interference, general hash created by small motors, fluorescent lamps, and the like that threaten the performance and shorten equipment life of unprotected electronic components.
SPECIFICATIONS:

- Electrical rating: 220-260 volts (AC) 50Hz 10 Amp
- Spike/ RFI Protection: 4,500 amps for 20m/ second pulses
- Maximum clamping voltage: 275V differential mode

X10088..................$69.95

MAINS MUFFLER

Sudden mains disturbances can seriously affect your computer equipment, and stored data. So why risk it when you can have a Mains Muffler, particularly when the cost of one failure is likely ti be greater than the purchase price!
So vanish those dangerous clicks and voltage spikes forever with the Mains Muffler!

SPECICATIONS:

- Maximum total load: 1000W, 4 AMP, 250V, 50 Hz
- Outlet Sockets: Attenuation: 150KHz-47dB, 500KHz-68dB, 10MHz-66dB
- Dual T Section: VDR Transient suppression. Surge capacity 200 Amp 8 x 20us

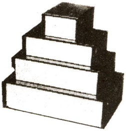
X10089 (2 Way).......$199
X10090 (4 Way).......$299

CASES

DIECAST BOXES

Diecast boxes are excellent for RF shielding, and strength. Screws are provided with each box.

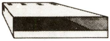
H11451	**100 x 50 x 25mm**	**$5.95**
H11452	**110 x 60 x 30mm**	**$6.50**
H11453	**120 x 65 x 40mm**	**$6.95**
H11461	**120 x 94 x 53mm**	**$11.50**
H11462	**188 x 120 x 78mm**	**$13.50**
H11464	**188 x 188 x 64mm**	**$29.50**



K&W METAL INSTRUMENT CASES

Used in many projects, these cases Have hammertone finish and are both versatile and economical

H10478	125 x 40 x 65mm	**$5.95**
H10479	150 x 55 x 95mm	**$6.95**
H10480	100 x 92 x 130mm	**$8.95**
H10481	150 x 55 x 100mm	**$7.95**
H10482	200 x 80 x 130mm	**$9.95**
H10485	255 x 92 x 155mm	**$14.95**
H10487	255 x 165x155mm	**$16.95**
H10489	305 x 105x200mm	**$16.95**



DUAL 8" SLIMLINE DRIVE CASE

X11025 Bare Case................**$109**
X11026 Case & PowerSupply**$275**

SINGLE 8" SLIMLINE DRIVE CASE

X11020 Bare case....................**$49**
X11022 Case & Power Supply**$179**

5 1/4" SLIMLINE DRIVE CASE

X11001 Bare Case................**$49**
X11011 Case & Power Supply**$109**

2 x 5 1/4" SLIMLINE DRIVES CASE

X11002 Bare Case...................**$69**
X11012 Case & Power Supply**$149**

ECONOMY 19" RACK CASE

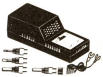
Save with this quality rack mount case complete with vents, handles and assembly screws. Tremendous Value!
Dimensions: 480 x 134 x 250mm
H10415..................$44.95

POWER SUPPLIE

4A REGULATED POWER PACK

- 240V AC input to 13.8V DC regulated 1A outlet
- Ideal for CB, ham radio, and other high power application
- Fully overload and short circuit protected
- Will handle up to 6A surge current
- Ripple less than 10mV peak-peak
- Large heatsink and vent system for cooling
- Outputs: screw terminals or 4mm banana sockets
- Illuminated on/ off switch
- Fuse protected
- Approved by the Department of Energy

M19032....................$13



1 AMP POWER PACK

- 240V AC to 6/ 7.5/ 9/ 12V DC
- Ideal for workshop
- DC connections via unique multi plug adaptor system
- Sizes: 2.5, 3.5mm phone and 2.1, 2.5mm DC plug
- Cord 1.6 metre long

M19010.................$36.9

PLUG IN POWER PAC

- 240V to 6/9/12V DC-300mA
- 1.6 metre cord with unique plug adaptors
- Plugs: 2.5 & 3.5 phone plugs, 2.1 &2.5mm DC plug

M19001.................$18.9

UNIVERSAL MULTI VOLTAGE PLUG IN POWER PACK

- 240V AC TO 3/ 4.5/ 6/ 7.5/ 9/ 12V DC-500mA
- 1.6 metre cord with unique plug adaptors
- Plugs: 2.5/ 3.5mm phone plugs, and 2.1/ 2.5mm DC plugs

M19005.................$21.9

REGULATED 2 AMP POWER PACK

- 240V AC TO 12V DC
- Ideal for CB and workshop us where large amounts of power are required
- DC connection with banana plugs or via screw terminals

M19030.................$69.95

SEMICONDUCTORS

IODES

at.	Descript.	10+	100+
0135	IN4148	$0.03	$0.02
0105	IN4002	$0.04	$0.03
0107	IN4004	$0.05	$0.04
0110	IN4007	$0.10	$0.06
0115	IN5404	$0.18	$0.14
0119	IN5408	$0.20	$0.16

at.	Descript.	1000+	10K
0135	IN4148	$0.015	$0.015
0105	IN4002	$0.03	$0.025
0107	IN4004	$0.03	$0.025
0110	IN4007	$0.05	$0.04
0115	IN5404	$0.13	$0.11
0119	IN5408	$0.15	$0.15

MAIL
ORDER
HOTLINE
008 335755

IEW LM12CLK

50W OP AMP................**$39.95**

SPO256 SPEECH CHIP

.............................**$21.95**

087 CHIPS

GENUINE INTEL CHIPS

087-3 (4.77 MHz)	$245
087-2 (8 MHz)	$350
087-1 (10 MHz)	$475
0287-6 (6 MHz)	$375
0287-8 (8 MHz)	$555
0287-10 (10 MHz)	$690
0387-16 (16 MHz)	$995
0387-20 (20 MHz)	$1460
0387-25 (25 MHz)	$1860

GENERAL PURPOSE TRANSISTORS

PN100: a NPN general purpose medium power amp and switch with contimuous collector current up to 500mA.

PN200: a PNP heneral purpose amp at collector currents to 1 Amp.

Both are TO-82 plastic package

PN100 REPLACES:

PN2221, PN2222, PN2222A, PN3585, PN3568, PN3569, PN3643, PN5133, 2N2219A, 2N2222A, 2N3414, 2N3415, 2N3416, 2N3417, 2N3700, 2N3704, 2N3904, 2N4123, 2N4124, 2N4401, 2N5088, 2N5210.

PN200 REPLACES:

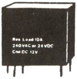
PN2907, PN2907A, PN3638, PN3638A, PN3640, PN3644, PN4121, PN4143, PN4248, PN4249, PN4250, PN4355, PN4916, PN4917, PN5910, 2N2905A, 2N3467, 2N3702, 2N3906, 2N4125, 2N4126, 2N4291, 2N4402, 2N4403, 2N5086, 2N5087, 2N5447.

PN100......T90001
PN200......T90002

1-9	10+	100+
$0.20	$0.18	$0.15

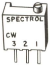
QUALITY LEDS

Cat. no.	Description	Price
Z10140	3mm Red	$0.15
Z10141	3mm Green	$0.20
Z10143	3mm Yellow	$0.20
Z10145	3mm Orange	$0.20
Z10150	5mm Red	$0.10
Z10151	5mm Green	$0.15
Z10152	5mm Orange	$0.15



RELAYS

	1-9	10+	100+
S.P.D.T. 3A connectors. S14060	$1.50	$1.30	$1.10
D.P.D.T. 3A connectors. S14061	$1.95	$1.75	$1.30
S.P.D.T. 12V Coil 10A 240V S14114	$7.95	$7.50	$6.95



SPECTROL 64Y MULTI TURN TRIMPOTS

Eg. R14700:Catologue number
10R:Description

R14700	10R	R14710	20R
R14720	50R	R14730	100R
R14740	200R	R14750	500R
R14760	1K	R14770	2K
R14780	5K	R14790	10K
R14800	20K	R14810	50K
R14820	100K	R14830	200K
R14840	500K	R14850	1M

Quantity

1-9	10+
$3.50ea	$3.20

SINGLE ROTARY POTS

6.35mm (1/4) PLAIN SHAFTS

LINEAR		LOG	
Value	Cat.No.	Value	Cat.No.
0.5	R12001	1K	R12023
1K	R12003	5K	R12O25
5K	R12005	10K	R12027
10K	R12007	25K	R12030
25K	R12010	50K	R12032
50K	R12012	100K	R12033
100K	R12013	250K	R12034
250K	R12014	500K	R12035
500K	R12015	1M	R12036
1M	R12016	2M	R12038
2M	R12018		

1-9	10+	100+
$1.75	$1.65	$1.30

DUAL ROTARY POTS

6.35mm (1/4") PLAIN SHAFTS

LINEAR		LOG	
Value	Cat.No.	Value	Cat.No.
10K	R12100	10K	R12120
25K	R12102	25K	R12122
50K	R12104	50K	R12124
100K	R12106	100K	R12126
250K	R12107	250K	R12127
500K	R12108	500K	R12128
1M	R12110	1M	R12130

1-9	10+	100+
$3.50	$3.25	$3.15

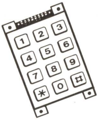
GENERAL COMPONENTS

RECHARGEABLE 12V 1.2AH GEL BATTERY

Leakproof, long service life batteries ideal for security systems, emergency lighting or as a computer backup power supply, etc.

Cat. S15029 Normally $19.95

1-9	10+
$13.95	$12.95



NUMERIC KEYPAD

Unencoded keypad, 10 digit keys plus two utility keys. Light grey in colour.

OUTPUT ARRANGEMENT

Output Pin No.	Symbol
1	N.A.
2	Shield plate
3	Column 2
4	Row 4
5	Column 3
6	Row 1
7	Column 1
8	Row 2
9	Row 3
10	N.A.

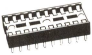
Catologue No. C19030

1-9	10+	100+
$2.95	$2.50	$1.95

UP-TO-DATE WORLD'S TRANSISTOR COMPARISON TABLE

with brief characteristics description

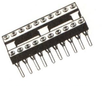
B10795..................**$19.50**



LOW PROFILE IC SOCKETS

Save a small fortune on these "Direct Import" low profile Ic sockets! PCB mounting solder tail. All tin plated phosphor bronze or berryllium and dual wipe for reliability.

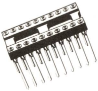
Cat. No.	Description	1-9	10+
P10550	8 pin	$0.20	$0.15
P10560	14 pin	$0.25	$0.20
P10565	16 pin	$0.35	$0.20
P10567	18 pin	$0.40	$0.30
P10568	20 pin	$0.40	$0.30
P10569	22 pin	$0.40	$0.30
P10570	24 pin	$0.40	$0.30
P10572	28 pin	$0.50	$0.40
P10575	40 pin	$0.50	$0.40



GOLD INSERT LOW PROFILE IC SOCKETS

- Gold machined pins
- Extremely high quality
- Anti-wicking
- Ideal for professional use or where field service components is required.

Cat.no.	Description	1-9	10+
P10620	8 pin	$1.20	$1.10
P10624	14 pin	$1.60	$1.50
P10626	16 pin	$1.90	$1.80
P10628	18 pin	$2.00	$1.80
P10630	20 pin	$2.20	$2.00
P10632	22 pin	$2.40	$2.20
P10634	24 pin	$2.60	$2.40
P10640	28 pin	$2.90	$2.60
P10644	40 pin	$3.00	$2.70



WIRE WRAP IC SOCKETS

These quality 3 level wire wrap sockets are tin-plated phosphor bronze

Cat.no.	Description	1-9	10+
P10579	8 pin	$1.50	$1.40
P10580	14 pin	$1.85	$1.70
P10585	16 pin	$1.95	$1.80
P10587	18 pin	$1.95	$1.80
P10590	20 pin	$2.95	$2.70
P10592	22 pin	$2.95	$2.70
P10594	24 pin	$3.95	$3.50
P10596	28 pin	$3.95	$3.50
P10598	40 pin	$4.95	$4.50

TEXTOOL SOCKETS

P17016	16 pin	$14.95
P17024	24 pin	$18.95
P17028	28 pin	$24.95
P17040	40 pin	$29.50

CHROME LED BEZELS

- 9mm hole, available 3 colours

Cat. no.	Description	Price
S14030	Red	$1.20
S14032	Green	$1.45
S14034	Yellow	$1.45

PLUGS & SOCKETS

RCA GOLD PLATED PLUGS AND SOCKETS

For those who need the ultimate in connection. Essential for compact disc players to get that fantastic sound quality

Plug (P10151)..............**$2.95**
Socket (P10150)..............**$2.25**

RCA GOLD PLATED CHASSIS SOCKET

For the ultimate connection!

Cat. no.P10229 Normally $1.75

1-9	10+	100+
$1.00	$0.90	$0.85

CANNON TYPE CONNECTORS AT SPECIAL PRICES !!

Cat. no.	Description	Price
P10960	3 pin line male	$2.90
P10962	3 pin chassis male	$2.40
P10964	3 pin chassis female	$3.25

rie

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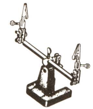
GENERAL TOOLS



PC BOARD HOLDER

Better than an extra pair of hands! A must for all PCB work.

T12444....................$9.95

ROYAL DUOTEMP SOLDERING IRONS

The DUOTEMP range are designed to idle with a normal tip temperature of 360°C, without its button depressed. In this mode they are ideal for delicate work such as printed circuit boards. With the button depressed, the power is doubled, allowing much heavier work to be completed, or a rapid temperature recovery from larger joins. A range of 6 long-life tips are available.
Note: This mode cannot be used continuously.

ROYEL DR-30: 21 WATT

- 3mm tip
- 240V operation, no transformer required
- Safety Standards Approved
- 6 months Warranty

T12640..................$39.50

ROYEL DR-50: 30 WATT

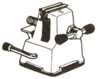
- 5mm tip
- 240V operation, no transformer required
- Safety Standards Approved
- 6 months warranty

T12645..................$44.50

ROYEL DR-60: 60 WATT

- 6.5mm tip
- 240V operation, no transformer required
- Safety Standards Approved
- 6 months warranty

T12650..................$49.50



MINIATURE HOBBY VICE

- Lever operated suction grip base for instant mounting and portability
- Mounts on smooth non-porous surfaces
- Ideal for holding components, and other small/ light objects

T12458....................$6.45

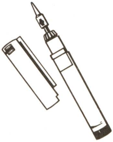
UV EPROM ERASER

Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less time for less chips)

- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures EPROMs are thoroughly erased
- Engineereed to prevent UV exposure
- Dimensions 217 x 80 x 68mm

Without timer
X14950.......................$79

With built-in timer
X14955.......................$99



PORTASOL PROFESSIONAL

- Four tools in one: Blow torch, Hot Blow or Hot Knife
- No Cords or batteries
- Heavy duty, tip temperature adjustable up to 400°C
- Equivalent to 10-60 watts
- Hard working. Average continuous use 90 minuters
- Refills in seconds
- Powered by standard butane gas lighter fuel
- Range of easily replaceable screw tips included
- Includes metal stand for the soldering iron when working
- Cap features buily-in flint for igniting Portasol tip
- Includes snap case for storage

T12639..................$89.95

PORTASOL PROFESSIONAL TIPS

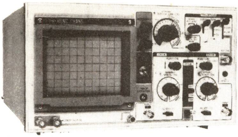
4.8mm (T12610).................$12.50
3.2mm (T12612).................$12.50
2.4mm (T12614).................$12.50
1.0mm (T12616).................$12.50

ECONOMY ANTISTATIC SOLDER SUCKER

- Light Weight
- Sturdy construction
- Easy to remove tip
- Excellent value for money

T11281..................$13.95

METERS



HUNG CHANG (RITRON) 20 MHz DUAL TRACE OSCILLOSCOPE

- Wide bandwidth and high sensitivity
- Internal graticule rectangular bright CRT
- Built in component tester
- Front panel trace rotater
- TV video sync filter
- Z axis (intensity modulation)
- High sensitivity X-Y mode
- Very low power consumption
- Regulated power supply circuit

Component tester is the special circuit with shich a single component or components in circuit can be easity tested. The display shows faults of components, size of a component value, and characteristics of components. This feature is ideal to trouble shoot solid state circuits and components with nbo circuit power. Testing signal (AC Max 2 mA) is supplied from the component test in terminal and the result of the test is fed back to the scope through the same test lead wire at the same time.

CRT

CRT: 6" (150mm) Flat-faced high brightness CRT with Internal Graticule.
EFFECTIVE DISPLAY AREA: 8 x 10 div (1 div=10mm)
ACCELERATION POTENTIAL: 2KV

VERTICAL

OPERATING MODES: CH-A, CH-B, DUAL, ADD (CH-B can be inverted). Dual modes: Alter; 0.2ufs-0.5ms/div. Chop; 1ms-0.5s/div
CHOP frequency 200KHz approximately
DEFLECTION FACTOR: 5mV/div 20V/div +/-3%, 12 ranges in 1-2-5 step with fine control
BANDWIDTH: DC; DC-20MHz (-3dB). AC; 10Hz-20MHz-3dB)
RISE TIME: Less than 17ns
OVERSHOOT: Less than 3%
INPUT IMPEDANCE: 1M ohm +/-5%, 20pF +/-3pF
MAXIMUM INPUT VOLTAGE: 600Vp-p or 300V (DC+AC Peak)
CHANNEL ISOLATION: Better than 60 dB at 1KHz

HORIZONTAL

SWEEP MODES: NORMAL, and AUTO
TIME BASE: 0.2ufs-0.5s/div +/-3%. 20 ranges in 1-2-5 step with fine control
SWEEP MAGNIFIER: 5 times (5X MAG)
LINEARITY:3%

TRIGGERING

SENSITIVITY: INTERNAL: 1 div or better for 20Hz-20MHz (Triggering to more than 30 MHz) EXTERNAL: 1Vp-p or better for DC-20MHz (Triggerable to more than 30MHz)
SOURCE: INT, CH-A, CH-B, line and EXT.
SLOPE: Positive and Negative, continuously variable with level control PULL AUTO for free-run
COUPLING: AC, HF-REJ and TV. TV SYNC Vertical and Horizontal Sync Separator Circuitry allows any portion of complex TV Video waveform to be synchronized and expanded for viewing TV-H (line) and TV-V(Frame) are switched automatically by SWEEP TIME/DIV switch. TV-V: 0.5s/div to 0.1ms/div. TV-H: 50ufs/div to 0.2ufs/div

X-Y OPERATIONS

X-Y OPERATIONS: CH-A: Y axis. CH-B: X axis Highest Sensitivity: 5mV/div

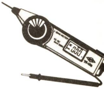
COMPONENT TESTER

COMPONENT TESTER: Max AC 9V at the terminal with no load. Maximum current 2mA when the terminal is shorted. (Internal resistance is 4.7K ohm)

OTHER SPECIFICATIONS

INTENSITY MODULATION: TTL LEVEL (3Vp-p); Positive.....Brighter.
Bandwidth; DC-1 MHz Maximum Input Voltage: 50V (DC+AC Peak)
Calibration Voltage: 0.5Vp-p +/-5%, 1KHz +/-5% Square wave.
Trace Rotation: Electrically adjustable on the front panel
Power Requirements: AC; 100,120, 220, 240V 20W
Weight: 7kg approximatiely
Size: 162(H) x 294(W) x 352(D) mm

Q12105...$695



DIGITAL METER

- Autoranging operation
- Data-hold for easy readout
- Full range protection
- Service temperature and humidity =0~40°C and below 80% RH
- Dimension & weight =133 x 2 x 17mm and 60g approx

Q11270.......................$6

METEX 4500H MULTIMETER

10A, 4 1/2 digit multimeter wit digital hold, transistor tester and audible continuity tester.

- Readout hold
- Transistor Tester
- 4 1/2 digit x 1/2"(H) LCD
- Audible continuity tester
- Quality set of probes
- Digital readout hold
- Built in tilting bail
- Instruction manual
- hFE test
- Diode Tester
- Vinyl case

Q91560....................$15

METEX 3800 MULTIMETER

Compact, rugged, battery operated, hand held 3 1/2 digit multimeter

- 1/2" high contrast LCD
- Automatic over-range indication with the "1" displayed
- Automatic polarity indication on DC ranges
- Diode testing with 1 mA fixed current
- Audible Continuity Test
- Transistor hFE Test

SPECIFICATIONS
Maximum Display: 1999 counts 3 1/2 digit type with automatic polarity indication
Indication Method: LCD display
Measuring Method: Dual-slope in A-D converter system
Over-range Indication: "1" Figure only in the display
Temperature Ranges: Operating 0°C to +40°C
Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

Q91530.......................$79

KITS
GENERAL

ELECTRIC FENCE

ains or battery powered, this ectric fence controller is both expensive and versatile. ased on an automative ignition oil, it should prove an itomative ignition coil, it hoild prove an adequate eterrent to all manner of vestock. dditionally, its operation omforms to the relevant auses of Australian Standard 129. (EA Sept. 82) 82EF9

82092..................$19.95

PHONE MINDER

ubbed the Phone Minder, this andy gadget functions as both bell extender and paging unit, r it can perform either function eparately. (EA Feb. 84) 84TP2

84021..................$27.50

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KITS
TV/ AUDIO

150W MOSFET POWER AMPLIFIER

Here's a high power, general purpose 150W Mosfet Power Amp Module! Suitable for guitar and P.A. applications and employing rugged, reliable Mosfets in the output stage. (ETI 499) (ETI March. 82) HEATSINK NOT INCLUDED

K44990..................$97.50
Plus transformer..$49.50

SOUND PRESSURE METER

Noise is one of the many pressures of todays often stressful lifestyle. To be able to combat noise in its many forms, you must be able to measure it. This low cost Sound Pressure Meter will measure sound levels of less than 30dB to more than 120dB, either fast or slow response to the "A" weighting curve. (EA May. 81, 81sp5)

K81053..................$39.50

CRYSTAL CONTROLLED TV PATTERN GENERATOR

Anyone withing to obtain the maximum performance from a colour TV reciever needs a pattern generator. Why not build this superg unit which provides five sepatate patterns; dot, crosshatch, checkerboard, grey scale and white raster?
Note: The RIE kit includes a large ABS type case!
(EA June. 80, 80pg6)

K80033..................$99.95

AUDIO TEST UNIT KIT

Just about everyone these days who has a stereo system also has a good cassette deck, but not many people are able to get the best performance from it. Out Audio Test Unit allows you to set your cassette recorder's bias for optimum frequency response for a given tape or alternatively, it allows you to find out which tape is best for your recorder.
(81AO10) (EA Oct. 81)

K81101..................$59.50

VOCAL CANCELLER

If you have ever imagined yourself as lead vocalist/ musician with a famous band, here is you chance to "audition" You can cancell out the lead vocal on almost any stereo record and substitute your own voice or musical instrument. (EA April. 82, 82vc3)

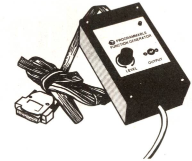
K82042..................$22.50

100W SUB-WOOFER AMPLIFIER

Capable of up to 120 watts Rms into 4 ohm loads and up to 80 watts RMS into 8 ohm loads, this power amplifier module has been specifically designed for use as a sub-woofer driver amplifier in a tri-amped hi-fi system. It uses four power Mosfets for rugged, reliable operation. (EA July. 82, 82PA7)

K82075..................$97.50

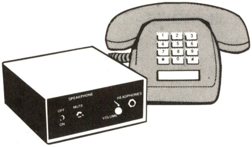
NEW KITS



PC DRIVEN FUNCTION GENERATOR

Here's a simple and low cost little unit which lets you use your personal computer to generate signals with almost any conceivable waveform. It hooks up to the computer via a standard Centronics-type parallel printer port, making it compatible with almost any kind of computer. Building and using it will also give you valuable insight into the growing trend towards computer-driven test instruments, too! Software included. (EA JAN 89)

K88111...$49.95



HANDS FREE SPEAKERPHONE

Here's a hands-free telephone that anyone can afford. With the speakerphone you can have relaxing conversations without the need to hold the phone to your ear. And if you are put on "hold" you can continue with you work while you wait. (SC SEP 88)

K88130...$89

DISCOLIGHT SC

These days when you go to hear your favourite band or disco there is always a top light show. Now you can have many of these exciting light show effects - with the Discolight (SC AUG 88)

K88125...$159

LOW COST TESTER FOR TRANSISTORS, FETS & ZENERS

This tester checks zener diodes as well as transistors and FETs, and also lets you check transistor breakdown voltages. Great for the work bench, and also for showing how semi-conductor devices operate.
(EA FEB 88)

K88013..................$54.95

PCB SHORTS LOCATOR

Here is a simple circuit to help you locate shorted tracks on printed circuit boards, by means of a varying audio tone. It is easily built and will cost you a lot less than equivalent commercial units.(EA FEB 89)

K88015..................$22.95

AUTOMOTIVE BRAKE LAMP MONITOR

Here's the project that won first prize in the Newcomer section of the recent Grand Aussie Hobby Electronics Contest. Low in cost and easy to build, it warns you if your vehicle's brake lamps aren't working as they should- hopefully before another motorist rams into your rear end! (EA MAR. 89)

K89030..................$24.95

HEAD PHONE AMP FOR CD PLAYERS

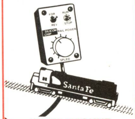
Does your compact disc player have a headphone socket? Now you can correct that situation and listen to the music direct, without degrading the sound quality (SC APRIL 88)

K88120..................$24.95

CAPACITANCE ADAPTOR FOR YOUR DMM

This clever adaptor circuit plugs into your digital multimeter and can measure capacitance up to 2.2 microfarads. (SC NOV 87)

K88119..................$24.99



WALK-AROUND THROTTLE FOR MODEL

This walk around throttle offers a host of features including pulse power, inertia (momentum), braking and full overload protection.
(SC APRIL 88)

K88122........................$89

PRINTER BUFFER

This external printer buffer will allow two computers to share one printer without the bother of swapping cables. Without dynamic ram (ETI 1620 FEB 89)

K56012................$139.95
Dynamic Ram (extra)...........$150

HIGH IMPEDANCE AC/DC MILLIVOLTMETER

With negligible circuit loading (EA DEC 88)

K88020..................$44.95

TV COLOUR BAR AND PATTERN GENERATOR

Here is a design for an easy to build colour bar and test pattern generator, suitable for servicing closed-circuit or amateur TV. It provides high performance at a very reasonable cost.
(EA OCT 87)

K87100...............$156.95

NOISE GATE

Eliminate annoying audio noises (ETI 1429 FEB 89)

K54215..................$49.95

HIGH ENERGY IGNITION SYSTEM

Are you still cleaning points, adjusting the dwell, checking timing and all that automotive drudgery? Now you can fit this High Energy Ignition System and forget those tuneup hassles
(SC SEP. 88)

K88135..................$49.95

ROD IRVING ELECTRONICS

Ferroelectronic RAM technology:

A revolution looming in computer memories

A small and – until last year – virtually unknown US subsidiary of an Australian firm has taken a leading role in the development of a new kind of semiconductor memory chip, which looks set to revolutionise the industry and render most other kinds of memory chip obsolete. Here's the story of Ramtron, and its ferroelectronic RAM or 'FRAM'.

by JIM ROWE

Back in the 1960's, computer memories generally consisted of arrays of tiny ferrite 'doughnut' cores, threaded on lattices of wires. By means of these wires, each core could be magnetised in either one direction or the other, to store a digital '1' or '0'. And because the magnetic storage was permanent, this single *bit* of information would remain in each core until it was either read out again, or over-written.

From a data storage point of view, these *ferrite core memories* were reasonably effective – although by modern standards they were not particularly fast. But even more serious was the fact that they were relatively bulky – and extremely costly, as each array of cores had to be threaded on the wire lattice by hand.

Of course ferrite core memories soon became obsolete, when advancing IC technology made it possible to store first hundreds, then thousands and now hundreds of thousands of bits of information in the same volume formerly taken by a single ferrite core and its write/sense wires. As a result, virtually all modern computers, from the smallest personal model to the largest mainframe use semiconductor memory chips.

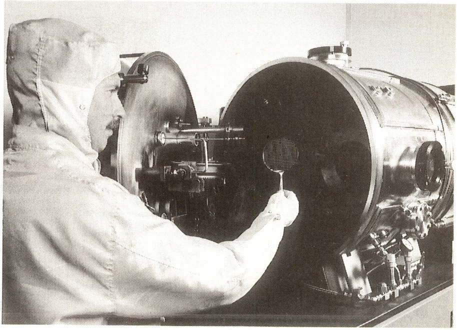
Generally they use a combination of dynamic random-access or 'DRAM' chips and/or static random-access or 'SRAM' chips for the main memory, with various kinds of read-only memory or 'ROM' used for storing relatively permanent reference information such as the basic input-output system program or BIOS.

Now while modern DRAM memory chips can store huge amounts of information (currently as much as 16 megabits in a single chip) and at a very low cost per bit, they do have a fairly serious shortcoming. And it's a limitation shared with SRAM chips, which although not capable of storing as much information, or as cheaply, tend to be rather faster in operation.

Unlike the old ferrite cores, both DRAMs and SRAMs provide storage which is *volatile* rather than permanent. When the supply voltage is removed, the stored data 'evaporates' and is lost.

Actually DRAMs are even more volatile than SRAMs, because an SRAM's memory cells are made up of transistor flipflops, which at least maintain their storage while ever power is supplied to the chip. But in the case of a DRAM, each bit of information is stored as the presence or absence of charge in a tiny capacitor. Because the charges tend to 'leak away' fairly quickly, even while power is applied to the chip, special 'refresh' circuitry must be used to maintain it – by repeatedly reading it out and re-writing it, every 20 milliseconds or so.

This volatility of both DRAMs and SRAMs means that if a computer's programs and data are not to be lost when power is turned off, they must be 'saved' first, by storing them on magnetic disks or tape. And they must then be re-loaded back into the computer's DRAM or SRAM chips, when it is turned on again, before the computer



Removing a silicon wafer from an ion miller in Ramtron's Class 100 clean room facility. The company's ferroelectronic technology is compatible with standard semiconductor fabrication techniques.

can continue operating.

Despite this fairly basic limitation, DRAMs and SRAMs have become very firmly established as the main memory storage elements in today's computers. And in fact it is largely *because* of this limitation that the various kinds of ROM chip have been developed: mask-programmed ROMs, fusible-link PROMs, UV-erasible EPROMs, electrically-erasible EEPROMs, and so on.

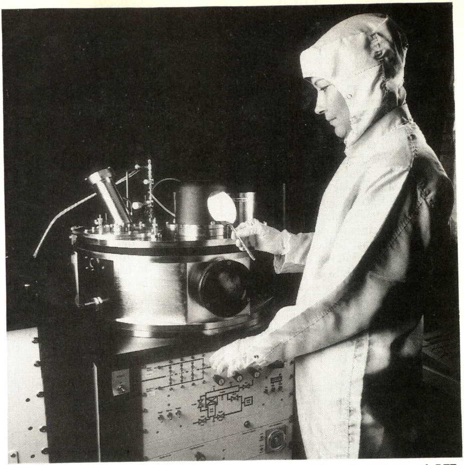
Each of these devices is capable of storing information either permanently or semi-permanently. But they generally require so much expenditure of energy and/or time, for the process of 'writing' the information into the storage cells, that they are effectively only suitable for 'write once/read many times' (WORM) applications. Hence the general classification of them all as essentially *read-only* memory, used most of the time only for (non-destructive) readout of stored information.

The ideal memory

Wouldn't it be great if you could have a semiconductor memory chip that packed in as much information as a DRAM and was no more complicated to make, but needed no refresh circuitry, and was capable of operating as fast as an SRAM – and at the same time was also truly non-volatile, so that its stored information was retained even when the power was turned off?

Such a chip would be the 'perfect' memory device, and needless to say it would render virtually all existing kinds of memory chip obsolete. It would also allow the cost of computers to be reduced significantly, by removing the need for refresh circuitry, memory backup batteries and so on. It would even allow operating system software to be simplified, by obviating the need to shuffle data back and forth between relatively slow main DRAM memory and faster SRAM 'cache' memory.

In time, it could even be used to replace conventional and relatively complex electromechanical mass storage devices such as floppy disks – and ultimately even hard disks.



Placing a silicon wafer into the equipment which deposits a layer of PZT (lead-zirconate-titanate) onto the existing semiconductor underlayers.

A foolish dream? Not at all. You may be surprised to learn that a new type of memory chip technology with exactly this performance and potential is already under development. And the results to date are so promising that already, many experts in the semiconductor industry are predicting that by the turn of the century, this new type of chip will have eclipsed all of the current types.

The name for this new type of memory chip is the *ferroelectronic RAM* or 'FRAM' ©, and it seems destined to become a 'milestone' development in memory chip technology, quite possibly as significant as the transistor or IC.

'Unknown' company

Currently the leading protagonist in the development of FRAM technology is a small and until recently almost unknown company in Colorado, USA. And the company concerned, Ramtron International Corporation, is actually a subsidiary of Australian company Ramtron Australia – before January 1988 known as Newtech Development Corporation.

But although Ramtron may not have been widely known before the beginning of 1988, such is the importance of its achievements to date with FRAM technology that its fame and status within the world-wide semiconductor industry are now growing dramatically.

Not long after details of the company's first big breakthroughs with the technology were released at the International Solid State Circuits Conference (ISSCC) in San Francisco, in February 1988, Ramtron signed a 6-year non-exclusive joint development agreement with big-league industry player ITT Semiconductors – which is now manufacturing FRAM chips.

Since then Ramtron has signed other strategic technology development alliances with NMB Semiconductors of Japan, US aerospace and defence group TRW, and (only a few weeks ago) with Seiko Epson of Japan, one of that country's leading makers of consumer electronics – including watches, personal computers and printers.

Ramtron Australia's MD Brian Harcourt explains that each of these agreements is part of a carefully planned strategy to ensure the rapid acceptance of the company's FRAM technology in the world's semiconductor markets. "Each of of the earlier contracts have targeted specific markets", he added, "and the agreement with Seiko Epson is an extension of this strategy."

Undoubtedly the fact that these large multi-national players are keen to enter into alliances with Ramtron also reveals the significance and potential they see in its FRAM technology.

This confidence is also reflected by the US investment market. Dun and Bradstreet electronics industry market research company Dataquest Inc has estimated that the sales of FRAM products could reach US$430 million by 1992, and that it also has the potential to achieve a significant share of the entire memory market – estimated to reach US$11 billion by 1991, and growing by about 13% annually.

Needless to say US investors both large and small are showing a lot of interest in the company, sensing that it is headed for the big time. In March this year, Ramtron announced that the US Pension Benefit Trust Fund of the National Electrical Contractors Association (with assets of US$3 billion) had purchased a US$12 million equity investment in Ramtron International, with an agreement that Ramtron can draw on a further US$7.5 million from the Fund on an 'as needed' basis, with the Fund granted associated share warrants.

Currently Ramtron Australia holds 55.5% of Ramtron International, with this equity planned to increase to 61% shortly so that if additional equity is acquired by the NECA Fund, the Australian shareholding will remain in excess of 51%.

Ramtron Australia's own shares are traded on the Australian Stock Exchange, and are also traded in the USA in the form of American Depositary Receipts (ADRs) under the NASDAQ system.

The funds raised by the NECA Fund investment are apparently to be used by Ramtron International to build a small production facility at its R&D headquarters in Colorado Springs, Colorado.

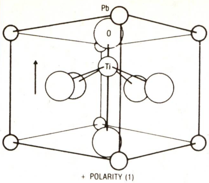
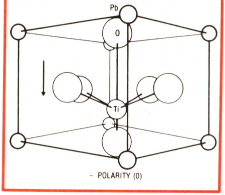


Fig.1: A unit cell of PZT has two stable electrical polarisation states, with the central titanium atom either 'up' as in (a) above, or 'down' as in (b) below. It can be flipped by an external field.



Small beginnings

The Ramtron story actually began in 1983, when Australians Ross Lyndon-James and Brian Harcourt started Newtech Development Corporation, to develop a number of new technologies – including a technique for applying ferroelectric materials to semiconductor devices, invented by George Rohrer, an engineer from a small town in Michigan, USA.

Newtech bought 51% of the rights to Rohrer's technique for $3.5 million, providing him with needed funds for further research. Then when this preliminary research was completed, the company purchased the remaining rights from Rohrer for $4 million.

Then followed further research on the technology via a joint R&D agreement with the University of Colorado at Colorado Springs, funded by Newtech at a cost of around $13 million.

By June 1986, the developing FRAM technology was looking so promising that the company decided to drop all of its other ventures, to concentrate all available resources on it. A research team was assembled, including such industry luminaries as Dr Fred Gnadinger and Sheffield Eaton, both founding team members of Inmos Corporation. **Sheffield Eaton is generally credited with playing a key role in the development of the world's fastest 256K DRAM chip design, now very widely used throughout the industry.**

Other members of the team included Richard Horton, director of business development of Honeywell's solid state electronics division, and with 15 years experience at Texas Instruments, and Douglas Butler, who also came from the Inmos process technology design team. Mr Horton is now President of Ramtron International.

In February 1988, one month after Newtech changed its name to Ramtron, the company announced its first practical FRAM memory chip at the ISSCC in San Francisco. This was the FMx801, a 256 x 1 bit non-volatile device based on a combination of CMOS SRAM technology with ferroelectric thin-film elements.

The FMx801 was essentially a vehicle to 'prove' FRAM technology in practical production, rather than a device intended to displace current memory chips. However currently nearing full production are 4K- and 16K-bit devices, using pairs of transistors and ferroelectric capacitors in each bit cell. And a 256K-bit chip, the first of a new family of high density 'integrated topology' devices with DRAM-type cells, is expected early in 1990.

Once the technology to produce this latter device is proven, there is apparently no inherent reason why Ramtron and its allies should not be able to produce FRAM chips with memory capacities equal to, or even greater than the DRAM devices currently under development.

So although the company is still as yet quite modest in size, it seems poised on the brink of entry into the world semiconductor industry's 'big league' – thanks to the solid technology developments it has achieved, and the strategic links it has forged. And similarly, FRAM technology looks set to bring about a revolution in memory chips, of at least the same magnitude as the development of the DRAM.

But let's have a look at this new technology itself, to see how FRAMs differ from the memory chips in current use – the chips they're likely to replace, before very long.

Ferroelectronics

The key to understanding the new technology is the *ferroelectric* effect, which despite the name, has nothing whatever to do with iron or ferrous compounds. In fact it's a somewhat embarrassing misnomer, dating from the time when the effect was first observed – and was thought (wrongly) to be related to the ferromagnetic properties displayed by iron compounds.

The phenomenon is actually charac-

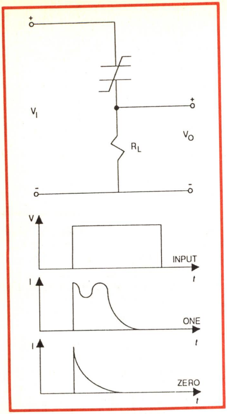


Fig.2: Data is read from a PZT capacitor by sensing the width of its displacement current pulse.

teristic of certain crystal materials, which tend to 'flip' into either of two opposite electrically *polarised* states, upon the application of an external electric field. And both states are stable, in that the crystal remains permanently polarised in one state or the other when the external field is removed. In other words, the crystal is capable of acting as an *electret* – the electrical equivalent of a permanent magnet.

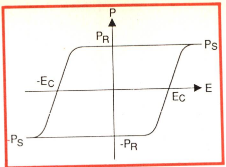


Fig.3: The electrical hysteresis loop for an ideal ferroelectric material. Note the similarity to a ferromagnetic B-H loop.

The first crystal discovered to exhibit the ferroelectric effect was sodium potassium tartrate tetra-hydrate, or 'Rochelle Salt', in 1921. Rochelle Salt was later used as the active element in gramophone pickups and microphones, because of another of its related properties: the piezoelectric effect.

Many new insulating ceramic materials developed in the 1940's were also found to exhibit the ferroelectric effect, including barium titanate.

But the material currently used for the ferroelectric elements of Ramtron's FRAMs is a complex thin-film ceramic consisting primarily of lead-zirconate-titanate, or 'PZT' – essentially the same basic material used in ceramic and SAW (surface acoustic wave) filters, and related to the copper-barium-oxygen 'Perovskite' ceramics used in the latest generation of higher-temperature superconducting materials.

The diagrams of Fig.1 show the mechanism believed to be responsible for the ability of PZT to possess two equally stable states of electrical polarisation. A basic crystalline 'unit cell' of PZT consists of eight lead atoms in a cubic configuration, enclosing a central structure with six oxygen atoms (in positions roughly corresponding to the centres of each face of the cube) and a single atom of titanium, which is nearest the very centre of the cell.

It turns out that the titanium atom can actually occupy either of two equally stable physical positions in this structure, due to the structure of the PZT molecule. And the actual position it adopts can be determined by applying an external field.

So if an external field is applied in the 'upwards' direction, as in Fig.1(a), the titanium atom flips to the uppermost position, as shown. And it will remain in this position when the external field is removed. But if an external field is applied in the opposite 'downwards' direction, as shown in Fig.1(b), it will 'flop' almost instantaneously to the lower position.

What this means, of course, is that every single crystalline unit cell of PZT is a potential 'flipflop' or binary storage element, capable of storing either a 1 or a 0 - i.e., one *bit* of information. And no external energy is required to *maintain* this stored information.

At present, of course, the technology is a long way from allowing us to store data in single molecules of PZT crystal. However the fact that this would be possible, at least in theory, shows that the ferroelectric effect has the *potential* for storing huge amounts of data in a very small volume – i.e., data storage densities far greater than even the 16-

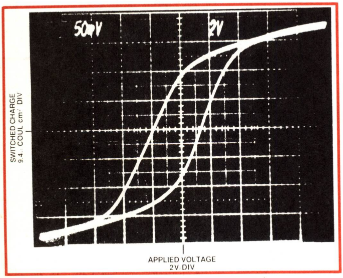


Fig.4: The electrical hysteresis loop for a typical PZT thin film capacitor. Although not 'ideal', it is still quite suitable for practical data storage.

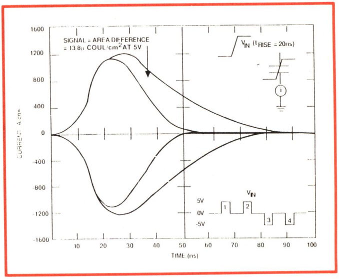


Fig.5: Actual current/time curves for a typical PZT capacitor. The shorter curves are for non-reversal of polarisation, the longer curves for reversal.

megabit DRAMs currently emerging from R&D labs.

At this stage, all we can do is store single bits of data in reasonably small volumes of PZT, in the form of thin film areas (a few microns square) deposited on the surface of standard CMOS IC chips.

How is the data stored in the PZT, and then read out again? Basically by using it as the dielectric of a capacitor. The effect of the PZT's ferroelectric behaviour is to give the capacitor a special kind of non-linearity, wherein it requires more displacement current to charge, when the electric field produced by the applied voltage is in the direction causing it to 'flip' its polarisation state, than when it is in the same direction as its current polarisation state.

Fig.2 shows the basic idea. When a pulse of voltage Vi is applied across the capacitor, the 'displacement' charging current drawn by the capacitor (and sensed as a voltage drop across R_L) will have one of two waveforms – depending upon the existing polarisation of the capacitor's PZT dielectric.

If Vi has a polarity such that the PZT has to flip over to the opposite polarisation, a relatively broad displacement current pulse will occur. This is shown in the upper I/t curve, labelled 'ONE'.

On the other hand if the polarity of Vi is such that the PZT is already polarised in that direction, a considerably narrower displacement current pulse will occur – as in the lower I/t curve, labelled 'ZERO'.

Storage of the data in the PZT capacitor is simply a matter of applying a pulse of sufficiently high voltage, of one polarity or the other, to ensure that the PZT will change its polarisation. The data is read out again by applying a similar pulse, but with a constant or 'reference' polarity, and noting whether the displacement current pulse drawn by the capacitor is 'narrow' or 'wide' – revealing its previous polarisation state.

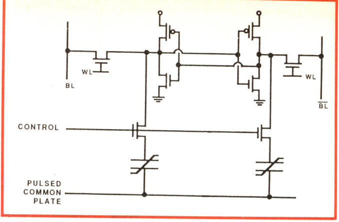


Fig.7: The circuit schematic for Ramtron's current FRAM memory cell, which consists of a standard 6-transistor SRAM cell coupled to a pair of ferroelectric storage capacitors.

Note that this readout process is inherently *destructive*, leaving the capacitor polarised in the direction corresponding to the readout pulse, regardless of its original polarisation. So the actual readout operation must be followed by a re-write operation, if the stored data bit is to be maintained in the capacitor. In this respect the PZT storage cell is again similar to ferrite magnetic cores.

Fig.3 shows the ideal polarisation hysteresis loop of a ferroelectric material. The horizontal axis E represents the applied electric field, while the vertical axis P represents the polarisation. The values Ec and -Ec represent the values of E necessary to produce a change in polarisation (i.e., threshold levels), while P_R and $-P_R$ represent the remanent polarisations following peak values Ps and -Ps.

Needless to say, a practical ferroelectric material like PZT doesn't achieve quite the same efficiency as this ideal curve. A typical hysteresis loop for PZT thin film is shown in Fig.4, for comparison. As you can see the remanent polarisation is somewhat lower than the peak threshold value for reliable switching, but is still quite acceptable for reliable and stable data storage.

Note that the switching threshold of PZT thin film is typically between 1 and 2 volts, making the material quite compatible with a 5V power supply. And switching time is currently around 60-100 nanoseconds – comparable with SRAMs and the fastest DRAMs. In principle this seems to be limited more by the electronics used to access the PZT cell than the basic ferroelectric switching mechanism.

The I-t curves for a practical PZT thin film capacitor undergoing polarisation reversal (longer curves) and non-reversal (shorter curves) with +/-5V applied pulses (20ns rise time) are shown in Fig.5, for both polarities. Note that switching occurs in well under 100ns, and that the curves are quite symmetrical for both polarities. Also that the difference between the reversal and non-reversal curves corresponds to a charge

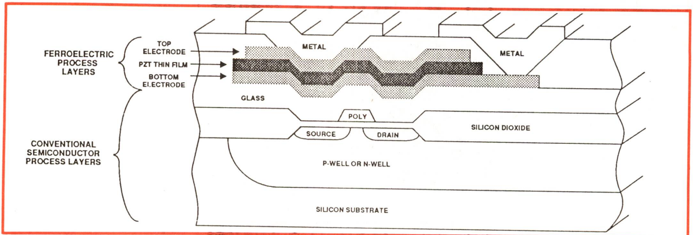


Fig.6: The physical construction of Ramtron's current devices. An array of ferroelectric capacitors is added to the top of a standard semiconductor chip, and interconnected to it via metallisation 'vias'.

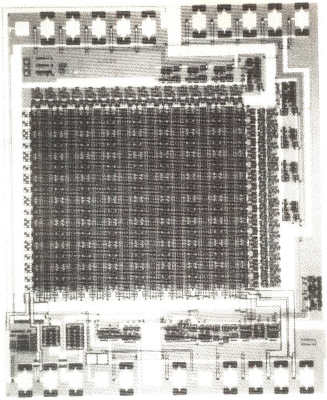


Fig.8: Much enlarged view of the FMx 801 256-bit FRAM device, made to demonstrate the technology.

differential of just on 14 microcoulombs per cm^2 – well within current limits for reliable signal detection.

Incidentally because PZT has a dielectric constant of 1200, or 300 times that of silicon dioxide, the PZT capacitor can store well over 100 times the charge per unit area of a normal silicon dioxide DRAM storage capacitor. More about this later.

How about temperature stability? A material like PZT certainly has a Curie temperature, above which the ferroelectric effect is lost. But in the case of PZT the Curie temperature is over 350°C – well beyond the operating temperature range of silicon and other current semiconductor materials. In other words, it will be the semiconductor material which limits the temperature capability of FRAMs, not the ferroelectric material. In fact the switching speed of PZT tends to increase, as the temperature is raised, until the Curie point is reached.

The only real question mark currently hanging over PZT material is that like earlier ferroelectric materials investigated, it does appear to suffer from *switching fatigue*. After a large number of polarisation reversals, the remanent electric charge begins to drop – i.e., the material's ferroelectric quality appears to 'wear out'. Life testing of current FRAM devices by Ramtron suggests that the remanent charge value of a PZT thin-film capacitor has fallen to 50% of its initial value after 10^{10} reversal cycles.

For its current FRAMs Ramtron has developed a technology which gets around this limitation very neatly, as we will see in a moment. Here the PZT capacitor is only used for data storage during power-up and power-down, with a parallel conventional SRAM cell used for storage during powered operation. This limits the polarisation switching of each PZT capacitor to power switching or failure cycles, giving a data retention 'life' of more than 11,000 years even if there were one power failure every hour!

Even so, Ramtron researchers are seeking to extend the polarisation endurance of PZT to beyond 10^{15} read-write cycles, as this will be necessary before the FRAM technology can really replace DRAMs. And they are apparently quite confident that this can be done.

Practical FRAMs

No doubt by this stage you're wondering how the basic PZT ferroelectric storage capacitor is actually combined with a conventional semiconductor memory chip, to produce an FRAM.

The basic physical construction of Ramtron's initial and current FRAM devices is shown in Fig.6. As you can see, the PZT thin film capacitor is formed directly on the surface of a conventional semiconductor chip. This means that no extra area is taken up by the capacitor, which can be built directly over the top of active chip areas.

In fact Ramtron stresses that its PZT technology can be used not just with silicon chips, but with gallium arsenide and other semiconductor substrates.

The current thin-film PZT capacitor of Fig.6 involves only three additional masking steps, over and above those used for the basic semiconductor chip. In other words, the fabricating process adds little extra complication. The electrodes of the PZT capacitor are connected to the underlying semiconductor circuitry by means of normal metallisation 'vias'.

In schematic form, the basic 'shadow RAM' memory cell used in Ramtron's current FRAMs is shown in Fig.7. It consists of a standard 6-transistor SRAM cell (shown at top), with two additional control transistors used to couple between each side of the SRAM flipflip and a pair of PZT capacitors.

During normal powered operation of the chip, the data is written to and read from the SRAM cell in the normal way, with the PZT capacitors not affecting operation. However upon loss of power, and before the SRAM data is lost, the control transistors are enabled and the capacitor common line is pulsed, whereupon the two capacitors become polarised according to the current data in the SRAM cell. The data is therefore transferred into the capacitors, where it remains stored when the power dies away.

Then when power-up does occur, the control transistors and capacitor common line are again pulsed. This causes the data which has been stored in the capacitors to be automatically transferred back into the SRAM cell during the powering-up process.

As noted earlier, this technique neatly gets around the PZT fatigue phenomenon, by causing polarisation to occur only during the actual power-down and power-up processes.

The term 'shadow FRAM' is meant to describe this technique, whereby the ferroelectric cells are effectively in parallel with the conventional SRAM cells in the memory array, both physically and electrically, but only take an active role during power-up and power-down. So the device works in most ways as a normal SRAM, except that it is now non-volatile.

Fig.8 shows the FMx801 FRAM chip, Ramtron's first commercial device, which uses SRAM-type cells of the type shown in Fig.7. This chip uses fairly conservative 3-micron CMOS technology. Later devices to be released shortly will use smaller design rules and a 4-transistor SRAM cell, giving capacities of up to 64K bits.

As you can see from Fig.6, this type of FRAM construction is in many ways a relatively crude grafting-together of the ferroelectric and conventional semiconductor technologies. The former is basically being grafted physically onto the top of the latter, with connections to link the two together electrically.

This is not to play down Ramtron's achievement in producing the devices – in fact many difficult problems had to be solved, in order to produce them, for which the company deserves much credit.

However once this had been achieved, it became clear that the real future of FRAM technology lay in being able to integrate the two technologies in a much more intimate, compact and efficient way. After all, the basic ferroelectric element is a 'bistable' capacitor, which could obviously form almost a complete data storage cell in itself.

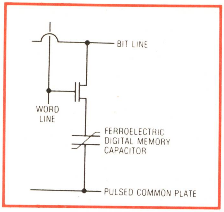


Fig.9: Ramtron is already developing an 'integrated' FRAM, using a 1-transistor/1-capacitor DRAM-type cell as shown here.

As it happens Ramtron is already in the process of developing such an 'integrated' FRAM, using a single DRAM-style transistor/single capacitor (1T/1C) storage cell as shown in Fig.9. Details of the physical structure used for this are still proprietary, but apparently the PZT ferroelectric capacitor is fabricated in a 'trench' within the surface of the chip, as with the latest DRAMs.

It should be fairly obvious that simply by virtue of this type of 1T/1C storage cell alone, FRAMs will in principle have the potential to achieve storage densities at least as high as current DRAMs. But don't forget the fact that PZT has a dielectric constant and charge/unit area capability many times that of the SiO_2 currently used as the dielectric in normal DRAMs – giving it the potential to achieve much higher densities again.

And of course this integrated FRAM will have two big advantages over current DRAMs: it won't need refreshing every few milliseconds, and it will be non-volatile!

When you consider this, it's not surprising that Ramtron and its FRAMs are attracting a lot of interest – and not just from the financial community. By the year 2000, we may well have single FRAM chips with capacities of 20 megabytes or more, capable of replacing hard disk drives in many applications.

Of course FRAMs using the 1T/1C cell of Fig.9 will require the PZT material to change polarisation each time data is written into, or read from a cell. This is why Ramtron is still putting a lot of effort into improving the 'fatigue' performance of the PZT material.

The company has apparently set a goal of raising the 'endurance' of the material to 10^{15} polarisation cycles, which would give a conservative 500,000 hour lifetime for 1T/1C FRAMs operating at 20MHz. And it's confident of achieving this goal, based on current R&D results.

Summary

I hope the foregoing has given you an interesting insight into this exciting new development in memory chip technology.

FRAMs certainly look set to make dramatic changes to the way we approach computer data storage. It's very much a technology to watch, from now on – along with Ramtron itself.

In closing I'd like to express grateful thanks to Richard Horton, President of Ramtron International, for his time and courtesy in providing a lot of the information on which this article is based. Also Ross Lyndon-James and Giles Wadham, of Ramtron Australia, for their valuable help as well.

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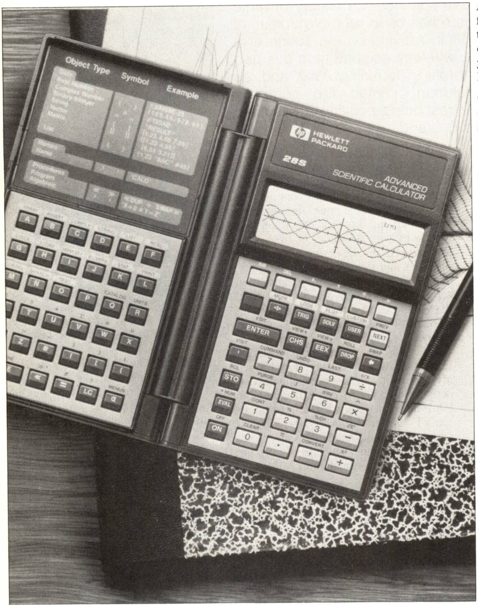

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When I Think Back...

by Neville Williams

Ernest T. Fisk: Pioneer, visionary and entrepreneur – 1

Over the 90-odd years that have spanned the history of radio and electronics in Australia, there has been no more dominant figure than that of Sir Ernest Fisk. Arriving on the scene at a time when there was very little wireless equipment in this part of the world, he played a vital role in founding AWA and, as Managing Director and Chairman, piloted the company through two world wars to the respected position it occupied when he returned to his native England.

Sir Ernest Fisk in later life, with eyes half-closed in characteristic fashion.

There was nothing about the boyhood of Ernest Thomas Fisk to suggest that he would one day become famous in far-off Australia, in the then little-known realm of wireless/radio/electronics.

Born in 1886 at Sunbury-on-Thames, near London, in modest circumstances, there was apparently no thought that he should do anything but attend local schools – and no misgivings when he started selling papers at the railway station to earn extra pocket money!

On leaving school, he took a job at a nearby engineering works and, in the normal way, would have become just another very small cog in Britain's huge turn-of-the-century industrial machine. But events in the world outside Sunbury-on-Thames had decreed otherwise.

Before young Ernie had even learned his ABC, Hertz and other researchers had documented most of the principles on which wireless telegraphy would operate. It remained only for entrepreneurial inventors like Guglielmo Marconi to get it all together and transform it into a practical – and much needed – 'wireless' communication system.

Ernest Fisk was just 10 years old, in 1896, when Marconi moved to England, attracting considerable attention from the press by so doing, along with somewhat controversial financial backing from the British Post Office. In fact, the move from his native Bologna in Italy was not all that surprising, considering his mother's strong Scottish/Irish family connections. (Ref. *Guglielmo Marconi* by David Gunstan, Heron Books, 1970)

In 1897, a Marconi transmitter was installed on the Isle of Wight; others followed in 1898, including one in the Bournemouth/Poole area. In the same year, Marconi reported the Kingstown regatta by wireless while, in 1899, wireless showed its life-saving potential in the Elba and Goodwin Sands disasters. Wireless messages were transmitted across the Channel, Marconi reported the America's Cup race, and equipment was demonstrated to the US Navy and Army.

The Marconi International Marine Communication Company was formed in 1900, with wireless communication demonstrated across the Atlantic in the following year from a Marconi transmitter at Poldhu in Cornwall, UK. Wireless telegraphy equipment had been installed, meanwhile, on ships of both the British and the German navy.

Operator & engineer

Fascinated by all this, and probably sensing an opportunity to see the world, Ernest Fisk joined the Marconi company circa 1906 at age 20 and commenced training in wireless engineering and operating procedures. In due course, his dream became a reality when he took his place as an accredited Marconi operator on Cunard trans-Atlantic liners.

That was just the beginning. In 1909, Fisk undertook a special mission to the Arctic and successfully demonstrated the possibilities of wireless communication to the Newfoundland sealing fleet. In the following year, he was assigned to the Orient line, which took him into oriental waters and on several trips to Australia as Marconi operator on board the *Otranto*.

At the time, there were no fully operational coastal stations in Australia with which to communicate – but on one such occasion, the young operator created something of a record when he managed to contact the British warship *Powerful* in Sydney Harbour, from a position 200 miles (320km) off Fremantle.

In 1911, Ernest Fisk chose to settle permanently in Australia, as a representative of the Marconi company. He set up a small office in Bond St, Sydney, transferring later to more pretentious premises in Challis House, in Sydney's Martin Place. On his own initiative, he organised a roster system whereby ships in Australian ports kept watch during allotted hours, thereby acting as temporary coast stations.

His move to Sydney was well timed, with both the Australian and the New Zealand governments debating the necessity to provide permanent land-based wireless stations, in order to communicate with shipping in the region. In the normal course of events, the necessary technology and equipment would have been supplied by Telefunken, in Germany, through a local company which had been set up some time previously: Australasian Wireless Ltd.

Back in Europe, rivalry between the Marconi company and the Telefunken group – which included Siemens and the German General Electric Co – had become bitter in the extreme, dating back to around 1897. It had culminated, circa 1912, in what came to be known as the Marconi Scandal, centering around an allegedly shonky deal between Marconi and the British Government under Lloyd George. At stake was an ambitious proposal to provide a chain of wireless relay stations, some 2000 miles (3200km) apart, linking countries of the British Empire.

Inevitably, the ramifications of the scandal and of worsening Anglo/German relations were felt in Australia. So also was the urgent need to provide improved maritime communications, highlighted by the loss of the *Titanic* in 1913 and other less publicised near-disasters in the same period.

AWA formed

Despite all this, in landmark negotiations, in which Ernest Fisk played an active role, a totally new Australian company was set up in 1913 'to acquire the rights to the patents, technical information, results of scientific research and the business of the world's leading wireless systems, and to develop them in Australia and New Zealand'.

With the initial support of the major parties – Marconi, Telefunken and the Australian government – the company so formed was Amalgamated Wireless A'Asia Ltd (AWA) with Ernest Fisk as its General Manager, and a member of the founding Board.

Three years later, at age 30, he was appointed Managing Director. From then on, the story of Ernest Fisk becomes inextricably interwoven with that of AWA and of many other prominent figures who are part of AWA's history. (Ref: '1913-1938, A quarter Century of Radio Engineering in Australia' by A.S.McDonald; 'Australian Radio Communication Services' by L.A.Hooke; and others, in the report of the IRE World Radio Convention, 1938).

Fisk the amateur!

'During the lecture (on Loop Aerials and Amplification by J.G.Reed) Mr Fisk, the President, offered a valuable suggestion to members concerning additional amplification secured by causing a tuned column of air to vibrate in resonance with the telephone diaphragms.

A telephone receiver is supported directly above a deep narrow-necked jar, and water slowly poured into the latter until resonance occurs. A very suitable container is a graduated 250cc chemical measure.

This phenomenon depends upon sound physical principles and is worthy of the attention of all experimenters who are after real sigs.'

(From *Sea, Land and Air*, April 1, 1921. The date is genuine!)

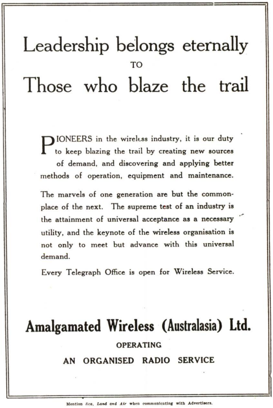
The new company set about its prime task of developing maritime communications in the region, and of training operators in the Sydney/Melbourne Marconi Schools of Wireless. But hardly had they opened when war was declared. Fisk himself sought to enlist in the AIF but was persuaded to remain in office, to coordinate the wartime activities of AWA.

From being a perceived need, maritime wireless communications suddenly became the focus of what has been described as 'frenzied activity', directly involving the Marconi company, Fisk, AWA and its recently recruited technical staff. It was essential to establish and maintain as many ground and shipboard wireless stations as possible – and equally essential for the armed forces to destroy, wherever feasible, those operated by the enemy!

AWA-trained operators were identified at short notice and seconded to monitor transmissions from the German Pacific fleet, initially from the HMAS Australia, but subsequently from listening stations set up around Australia, New Zealand and New Guinea. A wireless link replaced the severed Australia/-Noumea undersea cable, and steps taken to provide back-up for other cables, all of which were vulnerable to enemy action.

Last year, in his Patron's Lecture to the IREE, His Excellency Sir Ninian Stephan, then Australia's Governor

With both broadcasting and direct international communication in the offing, Fisk was determined that AWA should be seen as the core company in Australia for all forms of wireless communication.



Leadership belongs eternally
TO
Those who blaze the trail

PIONEERS in the wireless industry, it is our duty to keep blazing the trail by creating new sources of demand, and discovering and applying better methods of operation, equipment and maintenance.

The marvels of one generation are but the commonplace of the next. The supreme test of an industry is the attainment of universal acceptance as a necessary utility, and the keynote of the wireless organisation is not only to meet but advance with this universal demand.

Every Telegraph Office is open for Wireless Service.

Amalgamated Wireless (Australasia) Ltd.
OPERATING
AN ORGANISED RADIO SERVICE

Mention *Sea, Land and Air* when communicating with Advertisers.

General, observed: "Fisk took a leading role in all this". Whimsically, he added: "...while also finding time to marry; in 1916 he married his Australian bride, Florence Chudleigh, at St John's Church, Gordon, NSW". (Ref: IREE *Monitor*, December 1988)

After WW1

Following the war, AWA under Fisk resumed its commercial involvement with national and international maritime communications, in close association with the Marconi company. Full-page advertisements in publications such as *Sea, Land and Air* for 1921/22 sought variously to:

- Boost AWA's corporate image: 'Pioneers in the wireless industry – blazing the trail – creating new sources of demand – discovering better methods of operation, equipment and maintenance...'
- Publicise their wireless telegram service at 6d (5c) per word: 'There is nothing that your friends on their ocean voyage will appreciate more than a Marconigram message of greeting from you ... Hand in your message at any telegraph office ashore, and it will be forwarded to the ship by the fastest service in the world'.
- Secure recruits for their Marconi School of Wireless based in Sydney and Melbourne. '180 wireless officers required during the next twelve months and the Marconi Schools have been commissioned to supply all of them'.

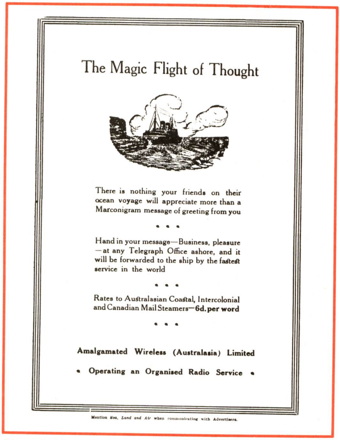
But while this was a 'bread and butter' area, with which Fisk was very familiar, he was keen to pursue the proposition which had earlier been scuttled by political scandal and the war – an Empire-wide wireless communications system.

Although a champion of Crown and Empire, Fisk had never favoured the British Government's 'chain relay' scheme. He considered that London/-Darwin messages, in particular, handled through relay points 2000 miles (3200km) apart, would be much too vulnerable. The cumulative delay would be unacceptable and the costs would be so high as to be non-competitive with cable circuits. As far as Fisk was concerned, the only practical approach was one-hop transmission and reception.

In September 1918, with the cooperation of Marchese Marconi and the Admiralty, he had demonstrated the point when he received and transcribed messages transmitted from the Navy station at Carnarvon, UK, to his own experimental station at Wahroonga, Sydney. This was at a wavelength of 14,300 metres or at the very low frequency (VLF) of 20.98kHz.

The occasion and the messages, from the Prime Minister the Rt.Hon. W.M.Hughes, and Navy Minister the Rt.Hon. Sir Joseph Cook, were widely publicised – which was a major objective of the exercise! 'Billy' Hughes was suitably impressed, and kept suitably aware of subsequent tests which demonstrated that, over long periods each day, wireless signals could also be received from USA, Italy, France and Germany.

At the 1921 Imperial Conference, on the advocacy of the Australian Prime Minister – advised by Ernest Fisk – Empire communications were reviewed and Britain agreed to cooperate in the Aus-



The Magic Flight of Thought

There is nothing your friends on their ocean voyage will appreciate more than a Marconigram message of greeting from you

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Hand in your message—Business, pleasure—at any Telegraph Office ashore, and it will be forwarded to the ship by the fastest service in the world

• • •

Rates to Australasian Coastal, Intercolonial and Canadian Mail Steamers—**6d. per word**

• • •

Amalgamated Wireless (Australasia) Limited

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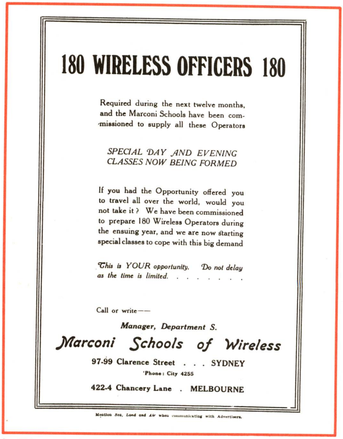
Aboard ship, travellers in the early '20s were isolated for long periods before the introduction of wireless telegraphy. Messages were sent by Morse code, as were old-time post office telegrams.



180 WIRELESS OFFICERS 180

Required during the next twelve months, and the Marconi Schools have been commissioned to supply all these Operators

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Manager, Department S.

Marconi Schools of Wireless

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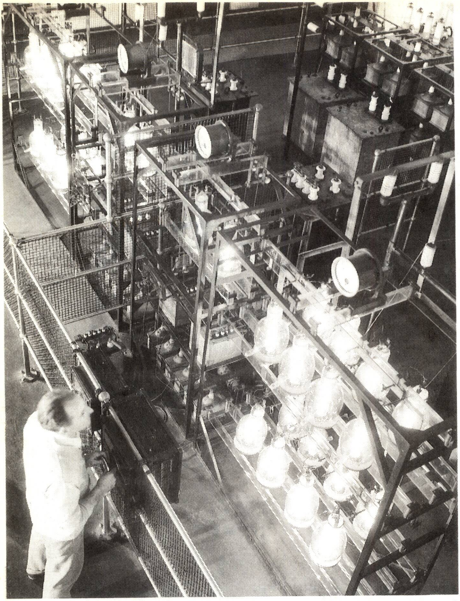
'Phone: City 4255
422-4 Chancery Lane . MELBOURNE

Mention *Sea, Land and Air* when communicating with Advertisers.

In this and similar full-page advertisements in the early '20s, Fisk was able to offer young Australians similar training to what he himself had commenced in Britain about 15 years earlier.



Transmitter racks at the Beam Wireless Centre in Ballan, Victoria around 1928.

tralian proposals, with other dominions following suit.

New AWA charter

In Australia, the direct result of all this was the appointment of a Federal Parliament Select Committee which recommended, inter alia, that the Government acquire a majority shareholding in AWA and, further:

'The company was to construct and maintain in Australia stations capable of direct commercial services to Canada and the United Kingdom; to provide for a suitable corresponding station in the United Kingdom; and to take over coastal radio stations which were operating at a considerable loss.'

'Certain guarantees regarding communication were also required, and the company was also to proceed with the development, manufacture, sale and use of radio apparatus'. (Ref: L.A.Hooke, IRE World Radio Convention, 1938).

During the ensuing discussions and negotiations, the initial agreement was modified in two important respects:

1. The British government assumed responsibility for the terminal in Britain, which freed Australia from its committment in that respect.
2. In the light of new research by the Marconi company, it was decided to base the system on the use of short waves – typically about 25 metres (12MHz) – which would allow the use of lower power and less costly directional antenna arrays, while ensuring more constant signal strength and greater freedom from atmospherics.

In due course, the Australian receivers and antennas were installed at Rockbank some 20 miles (32km) NW of Melbourne, with the transmitting system at Fiskville (later renamed Ballan) 40 miles (64km) beyond. By suitably interconnecting the antenna elements, signals could be directed either way around the world to Britain or Canada, depending on propagation conditions.

The so-called 'Beam' service was opened in April, 1927. (L.A.Hooke's paper, referred to earlier, illustrates the international services, coastal and Pacific island radio stations, and air routes in 1938).

In the second half of this article, to be published next month, I will talk more about Fisk – the man.

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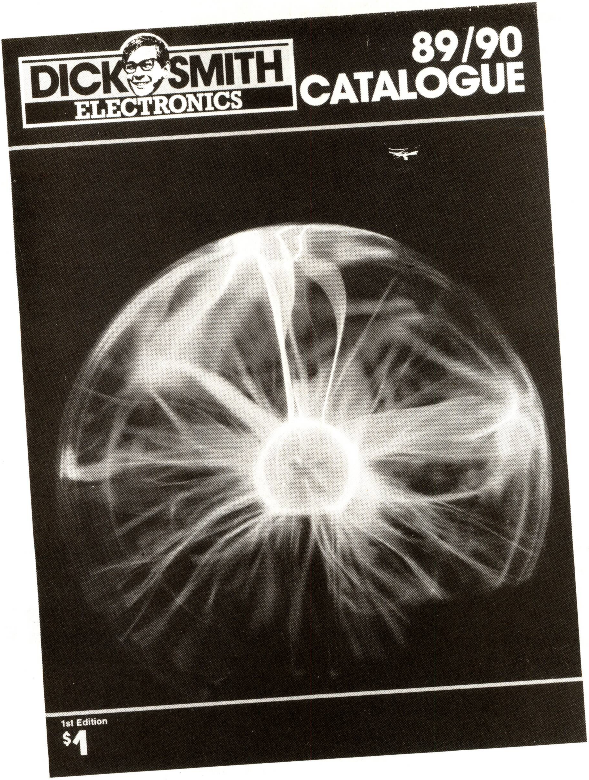

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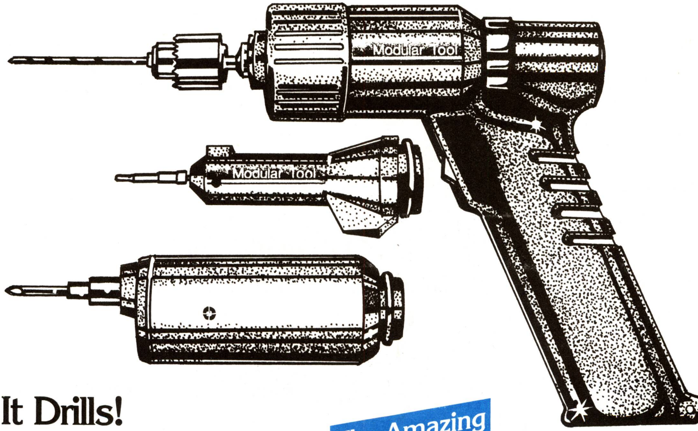

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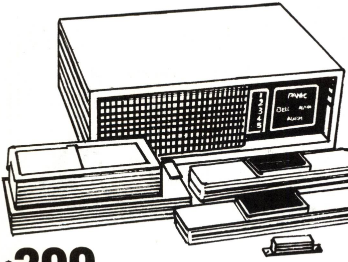

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Five zone protection for your home that can be installed in no time - Without Wiring! It's the ideal security system for home units, apartments, etc - or where ever wiring is a problem.

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That's right, all you have to do is plug it in, set the code and you've got instant protection.

Safe As Houses

With features like instant/delay modes, five zones of protection, 4 function modes, built-in speaker and provision for external speaker you get quality security in a compact unit which fits easily on bookshelf or bench.

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Yes, it comes as a complete security package. You get the central alarm unit, a remote controller, a remote Reed switch (for door or window protection), infrared sensor (for room or entrance surveillance) and mains adaptor! Cat L-5125

ADDITIONAL UNITS AVAILABLE

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Allows full control of your wireless remote security system. The remote controller fits in pocket or bag and allows you select any of the system's functions. Even has an emergency button. Cat L-5129

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Ideal protection for windows or doors! A magnetic Reed switch with digital coding transmitter. Incredibly easy to install, just set the security code and forget it. Cat L-5127

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Infrared sensors are the best sensors you can get. For full room, hall or entrance protection this one offers 64 sq metre coverage and adjustable zone control. Has inbuilt transmitter. Cat L-5128

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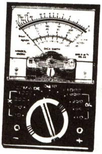

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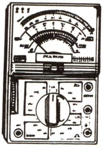

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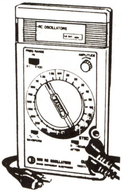
Now Just $29^95

Hand-Held RC Oscillator



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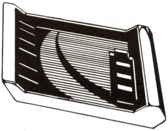
A great Idea!

Multimeter Holster



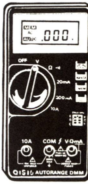
Impact absorbing case to protect your multimeter that's ideal for the bench of field work. Comes complete with belt and allows you to carry your Q-1515 or Q-1516 multimeter around without it being a hassle. Cat Q-1522

Was $9.95 Now

$7^95

Auto-Ranging 3.5 Digit

With Memory!

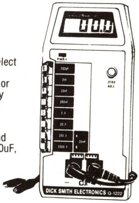


Auto-ranging makes worker easier and faster - you don't have to worry about what setting you're on! This super meter also has auto-polarity PLUS high levels of overload protection on all ranges. Features include 'lo ohms' setting which limits o/c voltage for in-circuit resistance measurements, a handy buzzer which sounds at 1.9 digits, switch selectable auto-ranging (manual gives extended resolution, transistor check, continuity and more! Cat Q-1516

Now $99!

It's NEW!

Digital Capacitance Meter



Can be used to check tolerances, sort values, select precision values, measure unmarked capacitors, select matched sets plus measure cable, switch or PCB capacitances. Ideal for the workshop, hobby bench, schools, labs....anywhere! With 3.5 digit LCD readings over 9 ranges. Covers virtually all general usage capacitors. Battery operated, it's lightweight and comes with handy carry case and leads. Ranges: 200pF, 2nF, 20nF, 200nf, 2uF, 20uF, 200uF, 2000uF, 20,000uF. With over-range and battery low indicators, overload protection and carry case Cat Q-1222

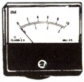
$129

With Bonus Offer!

Universal Panel Meters

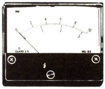
Quality universal 100uA panel meters in two popular sizes that can easily be adapted for just about any application - Volts, Amps. mA...anything. Combine them with Shunt Pack (Q-2046) and meter instrument labels (N-5751). They operate over the range 100uA to 316mA and 1V to 100V. Higher currents are available by providing an appropriate resistance.

SMALL MU45 With Bonus!



Overall size 55 x 52mm. 45mm mounting hole required. Cat Q-2045 **$16^95**

LARGE MU65 With Bonus!



Overall size 96 x 82mm. 65mm mounting hole required. Cat Q-2065 **$21^95**

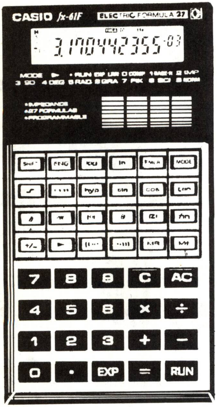
Bonus Offer!

With every purchase of universal Panel Meter(s) you'll get a BONUS Shunt Pack (Q-2046) for FREE! Hurry, this offer won't last!

DICK SMITH ELECTRONICS

A MUST FOR

THE ENTHUSIAST, ELECTRICIAN, EXPERIMENTER...



With 27 Electronics/Electrical Formula

The CASIO fx-61f

Without doubt one of the most useful tools anyone working with electronics could have! With 27 of the most used electronics/ electrical formulas built-in and a programming function which allows you to input your own formula. Includes 74 scientific functions, 10 digit display, programming functions .... it's unbelievable.

Just Look!

It's all built in - Resonance frequency, change in terminal voltage in RC series circuit, time constant in RC series circuit, resistance, power factor, closed loop gain, voltage gain, current gain, magnetic force, energy density stored in electrostatic field, standard electrical formula and more!

Cat V- 3828

Just $79.95

ALL NEW! COMPUTER PERIPHERALS

RS-232 Multilink Adaptor

A complete in-line tester/adaptor which makes complex and time consuming Serial connections a breeze. Comes with 25 pin male and 25 pin female connectors, jumper pads and wires, as well as 24 in-line switches, for quick selection for any RS-232 configuration. 8 bicolour LED's tell you at a glance when you've got it right. Cat X-2654

$49.95

Creative Music System

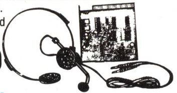
The Creative Music Synthesizer card plugs into your IBM PC or compatible and gives you 12 channels (Voices) stereo music output and 32 preset instruments. Plus, there's a stereo amplifier to drive speakers, headphones etc. You can define your own instruments, play background music while you work, create albums of your favourites or compose your own music. Cat X-2020

$299

'Voice Master' Sound Input Card

Analogue to digital card lets you sample any sound, then view and edit the wave form. If you have 'Speech Thing' the recorded sound can then be played back. Comes with headset and software for experimenting with voice recognition. Set up to 256 different voice activated keyboard macros. Requires an 8-bit expansion slot (XT & AT compatible). Cat X-2038

$199



Copy Images Direct To The Screen!

Handy Scanner

Now you can copy any image direct to your computer screen with the incredible Handy Scanner! 105mm wide, Handy Scanner can be used with Hercules, VGA, EGA or CGA displays. Gives black and white and 3 x 32 quasi-tones. With high 400DPI resolution. Suitable for PC/XT/ AT and compatibles and comes complete with Desktop Publishing Editor. Cat X-3825

$399

'The Speech Thing' Digital Sound Synthesizer

Adds sound capability to your PC! It's a full featured 8-bit digital to analogue converter, audio amplifier and software system which is capable of creating almost any sound. Converts text to high quality speech. Just plug it in. Can be used in conjunction with the 'Voicemaster' (X-2038) to sample and edit digital sounds. Cat X-2036

$149

DICK SMITH COMPUTERS

WHY NOT BUILD YOUR OWN?

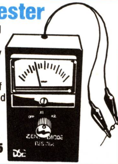
Motorcycle Alarm

An effective motorcycle alarm designed for maximum security at a great low price! Even if you know nothing about electronics you can have it up and running in no time. Features include LED alarm indicator, auto reset and provision for external sensor switches. Connect it to your existing horn or a siren. Suits all 12V systems and can be engaged by toggle or keyswitch. Comes complete with micro siren and compact Zippy Box.
Cat K-3249

$39.95

Zener Diode Tester

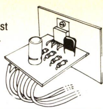
A handy device that's essential for the service bench or the hobbyist. Allows you to identify all those diodes where the markings have rubbed off. You get a direct readout, in volts, of the Zener voltage of 400mW and 1W Zeners from 3.3 to 50 volts (2 ranges). Supplied with pre-punched front panel.
Cat K-3051



$39.95

30W Audio Power Amp Module

Even a beginner will find this one easy to build! It would have to be the simplest (and possibly the smallest) audio power amp above a few watts ever described. Uses one common IC (National Semiconductors LM1875) and requires just 8 components on a minute printed circuit board, yet it delivers superb hi-fi performance. Comes with PCB and components only.
Cat K-5002

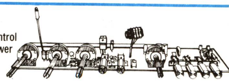


As Described in AEM 11/88

$16.95

Stereo Control Unit

It's great value! Use it as a stand alone stereo control unit/preamp or match it up with your existing power amp. Either way you get a high quality stereo control unit at a fraction of the commercial price.

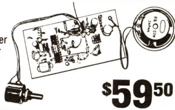


It's easy enough to construct, even by a novice, and features the full range of controls - inputs and outputs. Rated output: 1V RMS into 10k ohms.
Cat K-3045

Just $89.95

VHF FM Monitor Receiver

This amazing little receiver can be constructed in a matter of hours and gives superb performance. A dual conversion receiver it uses the Motorola MC3362 integrated circuit, is of low-power design with excellent sensitivity, low power drain and good image rejection in narrow band voice and data link applications. Cat K-6000

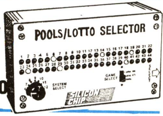


$59.50

Pools/Lotto Selector

An inexpensive, easy to build random number selector which may well be the best investment of your life. All you do is select the game you wish to play, Pools/Lotto/Lotto 44, push the button and it selects your winning numbers for you. Even has a systems select control for systems 6/7/8/9/10/11/12.
Comes with pre-drilled and screened front panel.
Cat K-3700

As described in Silicon Chip

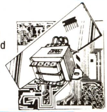


$59.50

30 Watt Stereo Amplifier

The very latest in the highly successful Playmaster series. A 30/30 watt stereo amplifier that's easy to build, low in cost, provides all the essential features and offers excellent performance and superb noise and distortion specifications. Construction is made easy by mounting virtually all parts, including heatsinks, on one large PCB. Short form kit comes with 2 x TDA 1514 IC's, front and rear panels, transformer, PCB and instructions.
Cat K-5100

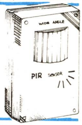
As described in EA 9/88



$99

Passive Infrared Detector

Small in size, simple to construct and it comes at less than half the cost of commercial units! Has 10 metre range and can be used in conjunction with your existing alarm system or with optional interface (Cat K-8201) you can use it as the basis for a complete new system for your home, etc. Comes with white filter so it can be used in the daylight (not direct sunlight) or even in the car.
Cat K-8200

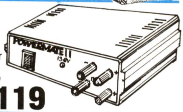


$39.95

Ideal for CB or Amateur Radio!

13.8V 5A Power Supply

One of the most popular power supplies for CB radio, amateur gear etc, has now been updated and improved. The Powermate II delivers clean, well-regulated 13.8V DC at up to 5amps. Comes complete with case, front panel and transformer. Cat K-7110



$119

NEW KITS SOON TO BE RELEASED.......

Teletext Decoder MkII A wealth of information at your fingertips...TAB results, news, stock market reports, sporting details, subtitles and more! Watch out for the amazing Teletext Decoder MkII. Comes complete with remote controller, mains transformer, case and silk screened, pre-punched front panel. Cat K-6360 **$299**

Car Courtesy Light Delay

A fantastic idea! Allows 20 second delay before the interior light turns off - enough time to find the keyhole, fasten seat belts, etc. Plus there's a dimmer control for map reading, etc and more! Easy to build, easy to install. Cat K-4002

FM Stereo Transmitter

A neat little device which allows you much more flexibility when listening to music. The Stereo FM transmitter can be connected to your CD player, etc and you can move around the house and listen to it via your Walkman portable. Or you can connect your portable CD to the transmitter and then listen to it via your car radio. Cat K-5004

DICK SMITH ELECTRONICS

THE GREAT KIT CLEARANCE!

GENERAL KITS

CAT NO.	KIT NAME	WAS	NOW
K-2720	Walkabout Wadio	$19.95	**$14.95**
K-2721	Motion Detector	$29.95	**$24.95**
K-3053	Power Transistor Tester	$19.95	**$14.95**
K-3082	Fluro Starter	$5.95	**$4.95**
K-3252	Deluxe Car Alarm	$89.00	**$79.95**
K-3415	AM Stereo Decoder	$32.95	**$19.95**
K-3425	Infrared Remote Control Suit Teletext K-6315	$41.95	**$19.95**
K-3428	Infrared Remote Control 240V SW	$69.95	**$49.95**
K-3429	Infrared Remote Transmitter Suit K-3428	$15.95	**$9.95**
K-3433	8 Channel I/R Remote Transmitter	$49.95	**$39.95**
K-3434	8 Channel I/R Remote Receiver	$127.00	**$99.00**
K-3460	Battery Power Supply	$62.50	**$49.95**
K-3470	RF Probe Suit K-3471	$9.95	**$7.95**
K-3471	Signal Tracer/Amp	$52.50	**$39.95**
K-3476	Fast Nicad Charger	$99.95	**$69.95**
K-3477	Mega-fast Charger Suit 7.2V cells	$45.00	**$39.95**
K-7000	Biometal Wire Starting Kit	$39.00	**$29.95**

AUDIO/VIDEO KITS

K-2722	Walkman Amp (PCB & Instructions)	$6.95	**$3.95**
K-3422	VCR Sound Processor	$59.95	**$39.95**
K-3441	60 Watt Mosfet Amp Module	$89.95	**$49.95**
K-3443	100 Watt Mosfet Amp Module	$109.00	**$59.95**
K-3998	Speaker Tweeter Suit K-4000	$12.95	**$6.95**
K-3999	Speaker Tweeter Suit K-4000	$39.95	**$29.75**
K-4000	Bookshelf Speaker Kit (everything but speakers)	$196.00	**$126.00**
K-4001	Low Cost Stereo Amp (No case & transformer)	$99.95	**$59.95**
K-4003	Infra-Red Stereo Pre-Amp	$259.00	**$199.00**
K-4005	Infra-Red Stereo Headphone Transmitter	$48.95	**$39.95**
K-4006	Infra-Red Stereo Headphone Receiver	$48.95	**$39.95**
K-6051	UHF/VHF Tuner Module (Pre-Built)	$32.95	**$19.95**

AMATEUR/COMMUNICATIONS

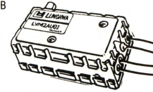
K-6300	UHF Transceiver	$249.95	**$179.00**
K-6301	UHF 40/80 Channel Upgrade (Suit K-6300)	$12.95	**$5.95**
K-6306	70 cm Pre-amp	$21.95	**$9.95**
K-6307	50 Watt UHF FM Power Amp	$279.00	**$179.00**
K-6309	UHF GaAsFet Pre-amp	$129.00	**$99.00**
K-6311	VHF GaAsFet Pre-amp	$129.00	**$79.00**
K-6313	100 Watt 2 Mtr Linear Amp	$299.00	**$229.00**
K-6316	VHF Watt Meter	$49.95	**$29.95**
K-6321	RF Field Strength Meter	$54.95	**$49.95**
K-6323	RF Attenuator Box	$79.95	**$59.95**
K-6326	80 Mtr Low Power Amateur CW-Tx	$49.95	**$39.95**
K-6327	80 Mtr VFO Kit Suit K-6326	$39.95	**$29.95**
K-6328	80 Mtr Direct Conv. Amateur Rx	$59.95	**$49.95**
K-6331	100 Watt H.F. Linear Amp	$379.00	**$249.00**
K-6339	Morse Rtty Decoder	$159.95	**$129.00**
K-6345	Radio Direction Finder	$149.00	**$89.00**
K-6349	100 Watt 6 Mtr Booster Amp	$329.00	**$249.00**

HURRY LIMITED STOCK ONLY!

DICK SMITH ELECTRONICS

Video Modulator

A high performance intercarrier vestigial sideband modulator intended for colour application use with TV games, VCR's, computers, graphic generators, Teletext and view data adaptors. Ensures a good grey scale, controlled chroma levels and freedom from sync compression that can cause frame and jitter problems. Operates over a wide supply range from 6V to 15V (Vcc) with excellent stability against voltage changes. Designed for PCB insertion with 75 ohm output from standard RCA socket. Cat K-6043



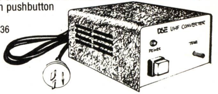
Was $19.95

1/2 Price!

Now $9.95

UHF/VHF Down Converter

Your TV doesn't have UHF? Then you're missing all the superb programs on SBS. Here's the inexpensive way to solve the problem. This UHF/VHF converter goes together easily, covers both UHF bands 4 & 5 and is a conventional varicap unit intended for use in TV's with pushbutton station selection. And there's no aligning or adjustments. Cat K-3236



Was $76.50

Now $69.95

HF Transceiver

Save An Incredible $100!

This has to be the bargain of the decade! A high quality amateur transceiver which gives any 500kHz segment between 2 and 30MHz (80 metre module supplied). With superb specs, it comes complete with case, silk screened panel, all components and even a microphone. With LSB, USB and CW modes and power output rated at 30W PEP/15W CW. **$299**
Cat K-6330

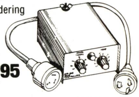
Upgrade Kits

40 Metre Cat K-6332
20 Metre Cat K-6333
15 Metre Cat K-6334
10 Metre Cat K-6337

Now $19.95 ea

Soldering Iron Temperature Controller

A great device which allows you to do all your soldering work with just one iron. It's not difficult to build and gives you a fully regulated, adjustable temperature control soldering system using your existing iron. 240V mains operated with selectable 20-70 watts. Can be adjusted to suit high power irons. Cat K-3479 **$20 OFF! $29.95**



Chair/Tilt Alarm

Fantastic little alarm with countless applications. As a chair alarm it helps care for your valued possession by screaming blue murder if the sitter swings back on it (the cause of death of many a favourite chair). Can also be used as an alarm for your golf bag, bike, backpack...anything. It's quite easy to build, battery operated and fits neatly in the smallest available jiffy box (not supplied).
Cat K-3248

$9.95

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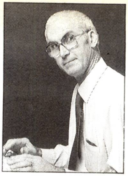
FORUM

Conducted by Jim Rowe



The 'boomerang' topic that keeps on coming back, every time!

Many moons ago, I foolishly raised the subject of double-insulated audio gear and whether or not it should be earthed – not for safety, but for satisfactory performance. Little did I realise at the time that the discussion would turn into a kind of boomerang, returning every few months to clout me over the head for my temerity, and 'take over' this column yet again...

Perhaps a better analogy would be with the *Marie Celeste*, that ship which had to keep on sailing endlessly, because (from memory) it wasn't allowed to put into a port. Or in this case, the topic presumably keeps on coming back because we never seem to reach a solution which satisfies all requirements of all concerned. And I suspect that neither we nor the SAA are ever going to reach such a solution, so that it may well keep coming back again and again – until we all get thoroughly sick of it.

We're not far from that stage now, I sense, but in view of the pile of letters that has accumulated on the topic over the last month or so, I think it would only be fair to give it at least this one further airing. Particularly as the expected flood of letters from my provocative April 'death of amateur radio' column hasn't started – at least so far.

So please bear with me, all of you out there who are already sick of the sound of 'double insulation', while I try to give the boomerang one last frenzied fling off into the vines and creepers!

As already noted, I've had quite a few further letters on the subject over the last month. There was a fairly lengthy one from Mr Ross Hawkins of Logan City, in Queensland, with a very careful explanation of the development of our 'multiple-earthed neutral' or MEN system, the reasons why it is earthed at all, and its various shortcomings and limitations. Mr Hawkins' letter was very informative, but as it deals with a 'background' topic rather than the specific question of earthing for double-insulated appliances, I can't really reproduce it here.

But thanks anyway for your courtesy in writing, Mr Hawkins, and I found the letter very interesting. I may be able to use some of the material in it in a later column.

Then there was a letter from Mr Don Pearce, of Erowal Bay NSW, arguing that it is precisely *because* our power mains are earthed that we have so many safety and other problems. Mr Pearce quotes an example from his youth, where a length of aluminium irrigation pipe he was holding, while standing in mud, came into contact with overhead power lines. He also notes the relatively small number of people electrocuted from home lighting plants, where generally neither side of the supply is earthed. And finally he asks "Let's hear your musings on a non-earthed system with a 'live' conductor in the swimming pool?"

On the other hand, a letter from Mr Lewis Cox of Glen Waverley in Victoria points out that using an unearthed and double-insulated electric drill can be positively lethal, if you drill into a live conductor inside a wall, while standing on a damp floor and using one hand to steady the drill chuck (as many of us do). Another fairly nasty example, for which there doesn't seem to be any really satisfactory answer at present.

Then there was a letter from well-known Victorian radio amateur Mr Roy Hartkopf, VK3AOH of Alphington, drawing attention to another aspect of capacitive leakage which I didn't cover in my previous discussion. This is the situation where a typical double-insulated 'plug-pack' supply is used to power circuitry with MOS ICs and other sensitive devices.

Mr Hartkopf points out that the output of typical plug-packs can 'float' at anything from 20V to 50V AC with respect to earth, and can carry with it any circuitry connected to the output. This can be a recipe for disaster, with devices being easily damaged when the circuit is being checked via leads connected to earthed test instruments – unless the common side of the circuitry is tied to earth first.

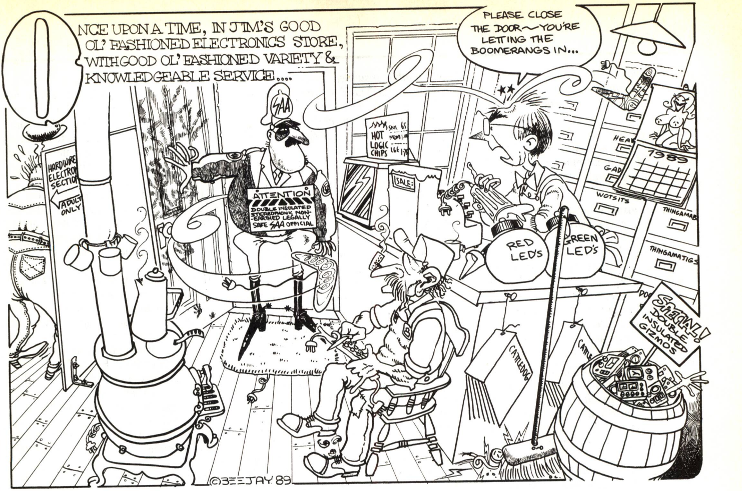
Mr Hartkopf also notes that similar havoc can be caused by soldering irons operated from double-insulated step-down transformers, unless they are fitted with an earth strap. Fair enough, both these points are most interesting and valuable – thank you, Mr Hartkopf – although they are again a little away from the original topic.

The main letter I would like to quote from at length comes from Mr Jeff Richards, who wrote one of the letters I discussed in the most recent iteration of this discussion, back in February. Jeff feels that I misinterpreted what he wrote then, and has written a fairly long follow-up epistle in order to clarify what he meant. It's a bit long, but in fairness to Jeff and the important points he's making, I'm reproducing almost all of it here:

I am disappointed that you have significantly misunderstood the point I was trying to make in in my previous letter. I had thought the argument was clearly put, but perhaps it needs clarification.

I stated that the aim of the labelling and wiring regulation was to do with "a legal obligation that the standards association wants to impose on the manufacturer". This legal obligation was to force the manufacturer to "stand by the safety of the device when operated unearthed". To this end, he must not be allowed to suggest that failing to earth the device was a possible cause of the injury. Labels with the term 'protective earth' could be regarded as suggesting that unearthed operation was unsafe, and could permit the manufacturer to avoid his obligations in the event of injury.

How you can read this as protecting the manufacturer and the SAA is beyond me. You appear to have almost grasped the point when you claim "by definition the injury or death couldn't be due to lack of an earth!". If it is not due to lack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of an earth, it surely follows that it must be due to faulty equipment, for which the manufacturer must be liable.

Consider this. The hifi equipment referred to in the other part of your February 'Forum' turns out to have a large screw connector on the metal back panel. Beneath it is a red and yellow sticker with the words:

ATTENTION - Safety Warning
For your continued safety, please ensure that this screw connector is wired throug h to a suitable earth point whenever the unit is connected to mains power . Failure to do so may result in injury.

The technician is badly injured when he is flung across the room by the live chassis. He claims worker's compensation, but his employer and the insurance company deny liability, as the unit was clearly operated in a manner contrary to the large and explicit warning message.

The technician sues the manufacturer. The manufacturer admits negligence – in the face of the evidence it would be hard not to. But the manufacturer then shows the court the clear and explicit warning label on the unit. The manufacturer produces evidence to show that, had the warning been heeded, the chance of injury would have been reduced or eliminated. The Judge agrees that an experienced technician should have noticed and heeded the warning. He is therefore, to some extent, responsible for his own injury. The amount of damages awarded is therefore reduced by a factor of 80%.

This situation is far from unrealistic – warning messages are there both to protect the user from his own actions, and to reduce the liability of the manufacturer should injury result from use of the equipment in an unsafe manner.

But the question is: should a device that carries such a warning gain certification as double insulated?

The answer is clearly NO! Such a warning may permit the manufacturer to escape from a significant part of his responsibility to ensure that the unit is safe when operated unearthed. Double insulated equipment should be manufactured so as to be safe to operate unearthed, and "there must be nothing to permit (the manufacturer) to claim 'improper operation' when it is so used".

Consider a second scenario. A hifi enthusiast imports a piece of specialised equipment that is labelled 'double insulated'. He notices that it has a separate connecting wire labelled 'protective earth', but when he connects this through to a common earth point he introduces an unacceptable hum loop. Deciding that it is a piece of additional protection he can do without, he permanently disconnects the wire – after all, the equipment is double insulated.

Next day the unit develops an internal fault, catches fire and burns the house down. The insurance company contacts the manufacturer and between them they decide that the householder was operating the equipment contrary to manufacturer's recommendations – claim denied.

Unlikely? Perhaps, but the point is relevant. The SAA is saying that provision of earth points and warnings about protective earths give the manufacturer too much of a chance to escape full responsibility for faulty equipment that causes damage or injury when operated unearthed. Double insulated equipment SHOULD NOT need additional earthing, and suggestions by the manufacturer that the provision of an earth improves safety could be read as recommendations to do so, and could be used by the manufacturer to offload, onto the operator, the manufacturer's responsibility for providing safe equipment.

Of course, the preferred situation would be that the additional protective devices and warnings are provided, but that failure to use the devices, or to heed the warnings, should never be an excuse for the manufacturer to avoid liability *for equipment that was not safe to use unearthed. Unfortunately, such a situation is not within the scope of a safety standard.*

To fully appreciate the significance of this point, it is necessary to understand that the SAA cannot make new law. The SAA may well prefer to have a rule to the effect:

> *Double insulated equipment may include protective earthing devices together with instructions relating to their use. However, under no circumstances will failure by the user to take advantage of such devices be construed as negligent or improper operation of the equipment, and shall not be used in any legal proceedings as part of an attempt to reduce or eliminate the manufacturer's liability.*

Such an attempt would be laughed out of court. It is so far outside the SAA's authority to try to tell a court what it can or cannot consider when assigning liability or assessing damages, that the SAA would (I am sure) not even contemplate trying.

Given the dilemma, the SAA has opted for the choice that ensures maximum protection of the user's legal rights. We must start from the basis that double insulated equipment is supposed to be safe to operate unearthed. If the provision of additional protective devices introduces the risk of the manufacturer avoiding some of his legal responsibility should the equipment be faulty, then double insulated equipment must not be permitted to include such devices. If there is any increased danger to the user (and the SAA would argue that the standard ensures this is negligible), then this is a risk that must be taken in ensuring that nothing dilutes the rights of an injured user to claim full compensation.

Of course, there is no need to make the USE of such protective devices illegal – they may well provide an extra measure of safety. The importer's technicians you refer to later in the article, who SHOULD be powering up each item of imported equipment, would certainly not want to operate without protective earth leads attached to the chassis. And your earlier comments about the need for earth leads in hifi equipment are quite correct.

The only point of contention is the fact that the standard prevents manufacturers from providing protective or safety earths with double insulated equipment. For my part, if I am ever injured by faulty double insulated gear that I am operating unearthed, I will be very grateful that the SAA has done its part in preventing the manufacturer from claiming 'improper operation!' and denying liability for faulty equipment.

Well Jeff, I must thank you for taking the trouble to write this second letter, which I believe has certainly clarified the position considerably. I don't quite know how I managed to get the wrong impression from your first letter - perhaps it was too much smoke from last year's fire, after all!

I'm relieved to learn that the whole idea of the SAA's prohibition against provision of a protective earth on a double-insulated appliance by the manufacturer is to ensure that the manufacturer (a) produces an appliance which is indeed fully safe to operate unearthed; and (b) cannot deny responsibility in the event that it is so used, and damage or injury results.

I guess there are only two main things I'm still a bit concerned about. One is that an unearthed double-insulated appliance may be totally 'safe', within the technical and legal meanings of that word, and yet as we've seen in previous discussions can still be able to deliver a disconcerting 'tingle' from its exposed metalwork, in certain circumstances.

It would seem to me, from what you've written, that if the user elects to connect the exposed metalwork of the appliance to a protective earth, to avoid getting this tingle, this may well reduce his legal protection in the event of damage or shock due to equipment failure.

The same applies with my second worry, which concerns the very problem which prompted me to raise the whole question of earthing, more than a year ago: quite apart from safety, or even 'tingles', it is often necessary to connect the 'common' side of electronic equipment such as hifi gear to earth, in order to obtain the best performance – in terms of minimum hum and highest signal-to-noise ratio. Despite the fact that more and more of this equipment is being marketed as 'double insulated', and therefore not provided with any earth – and frequently lacks any easy means to provide such a 'functional' earth.

Yet if the user does elect to provide such a double-insulated appliance with a 'functional' earth, it seems likely from what Jeff Richards has written that this may well reduce his legal protection in the event of any breakdown or shock.

In other words, providing either an 'anti-tingle' earth or an 'improved function' earth may provide a 'loophole' through which the manufacturer (and perhaps also the SAA) is able to avoid responsibility, by claiming 'improper operation'.

This is because the SAA seems to have made such a 'thing' about the injunction that double-insulated appliances must *not* be earthed – suggesting that to do so may actually prejudice user safety.

Jeff Richards may well be right, in that this is really an injunction only against the *manufacturer* providing such an earth, and possibly taking advantage of it to avoid either providing the correct degree of double insulation, or his legal responsibilities. But the impression given, perhaps inadvertently, is that providing such an earth is dangerous *per se*, regardless of by whom it's provided. And perhaps that would be all that's needed by a good barrister, seeking to minimise his client's responsibilities.

Frankly I cannot for the life of me see how, if an appliance is indeed properly double insulated, its safety would in any way be compromised by providing an earth connection – whether this be to avoid tingles, or to reduce hum and noise. If anything, as far as I'm concerned, it *must* improve the safety slightly.

But as a non-lawyer, I have to admit that it wouldn't surprise me to learn that a good lawyer could turn this kind of slight advantage into a serious liability – given the right opportunity and motivation. After all, objective technical reality seems to have only limited relevance in our courts, based as they are on the histrionic adversary system.

So where does that leave we poor users, faced with more and more double-insulated electronic gear, and knowing full well that we can often improve its performance by providing a 'functional' earth? Or the user with a double-insulated TV set that's officially safe, yet delivers a nasty tingle – which can be prevented simply by providing a 'capacitive leakage drain' earth?

Do we hook up the gear to an earth, and possibly run the risk of losing our rights in the event of an accident? Or do we 'play safe' in the legal sense, avoid connecting them to earth and simply put up with the hum and noise and tingles?

I'm blessed if I know, folks. It seems like Hobson's Choice to me, because neither of these alternatives is really acceptable. Surely you shouldn't have to give up your legal rights regarding appliance safety, merely in order to get them working in an acceptable fashion.

There must be some sensible answer to this technical/legal dilemma, I feel sure. Perhaps someone with a better knowledge of the law than I, such as Jeff Richards, can find it. I certainly hope so.

Component quality

Before closing this month, and to change the subject away from double insulation ("At last!" I hear you exclaim), I've had a couple of responses to my whinge about component quality and availability, in the March column.

One was from Gary Johnston, the MD of Jaycar, whose letter defending his company's generally excellent stock range was published in last month's *Letters to the Editor* columns. I don't think there's any need to comment on Gary's letter further here, as he made his points quite forcefully – and in any case had conceded some of my own points. So we probably ended up with a score of 'deuce', even though Gary might want to claim 'advantage receiver'!

But only a couple of days ago a second letter arrived on the same topic, this time from Peter King, of Procon Technology in Essendon, Victoria. In general Peter seems to agree with many of the points I raised, as you can see:

It seems that you have almost 'read my mind' in the March 'Forum' column. I was thinking about writing to you concerning 'The great Taiwanese substitution racket', which appears to be going on in electronics stores throughout the country!

I refer, in particular, to the questionable quality components from Taiwan that are finding their way onto the shelves of electronics stores. This perhaps would not be so bad if the savings were passed on to customers, however this is not always the case.

One store in Melbourne, ---, with whom I have dealt for over 15 odd years is particularly guilty of this practice. They have not changed their catalog for over 2 years, with its photographs showing good quality components. However when one makes a purchase you often find a cheap Taiwanese product in its place.

Over the past year I have returned a number of these components, including: red and green LEDs with different dimensional characteristics and poor light output; 25-pin crimp plugs with 'gold plating' flaking off and mis-aligned crimp pins; and an IC insertion tool (costing $20) whose chrome plating started flaking off after the first use.

I must say that not all Taiwanese products are of poor quality. Perhaps 50% may be OK – but which 50%!? It did amuse me, however, that Hong Kong computer manufacturers would advertise their products with the line: 'ALL JAPANESE COMPONENTS'. Now we know why!

Part of the problem, I believe, is that staff in the purchasing departments have little knowledge of what they are buying, and are trying to squeeze extra profits out of consumers, with little consideration of quality and reliability.

An example of their poor decision making is the case of Radio Parts, who for a long time did not stock a 74LS245. I asked the counter staff about this and they would say that it was entirely out of their hands. Now they stock the 74LS245 but have removed the 74LS374 from their catalog.

Another example is Dick Smith Electronics, which only stocks the LS range of TTL logic chips. But what about those who require a high current, high voltage driver like the 7406? Who is making these ad-hoc decisions, I wonder?

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I have also observed a definite deterioration in the service provided by counter staff. At one time they could be relied upon to provide advice and assistance in locating a component or finding a substitute. Now, it seems, the young staff (including a few of the female gender) have little or no knowledge of electronics!

It would be unfair to suggest that only Radio Parts has this problem – although they have lost me as a customer forever. I have also had difficulty with Dick Smith Electronics, Rod Irving Electronics, Soanar and others. I have decided to pay that much more for the service and quality I expect. I now make frequent use of RS Components for small quantities, and the established component wholesalers for larger quantities. It means, however, that it is impossible to buy everything from the one supplier.

On the question of direction of your industry, it seems that the electronics era is over (remember you used to be called 'Radio and Hobbies'), so enter the computer era! It seems that much of the consumer dollars that were spent on electronics in the past are now being spent on computers. You are competing with computer hardware and software for readers' attention and dollars. Indeed, many of the projects that once were performed by little electronic gadgets can now be done on a computer anyway!

One final comment is that I find it rather alarming that no magazine in Australia caters for the computer hacker – the equivalent of 'Byte' magazine in the USA.

Thanks for the comments, Peter. You'll notice that I have not reproduced the name of the Melbourne firm you first mentioned, in case of possible legal difficulties for both you and ourselves.

I'm sure most people will agree that showing high quality parts in a catalog and then substituting items of poorer quality is a very nasty practice – and surely one that should be drawn to the attention of the relevant authorities. On the other hand if you strike parts with really bad quality and plating that flakes off (or turns out to be unsolderable), the best idea seems to be to take them back to the store, and complain. In my own experience, doing this generally gets action from most suppliers – who in most cases will not only replace the items with good ones (if they have them), but also chase up the problem with their overseas supplier.

I doubt whether any company knowingly sells inferior parts; it probably happens by default, without anyone spotting that a batch is faulty. Although there's also undoubtedly some truth in what you say about staff in purchasing departments with little product knowledge, and pushed to obtain the 'best deal' first and foremost, with rather less emphasis on quality and reliability than we customers would wish.

Although you admit that not all products from Taiwan are of poor quality, I would like to add that from my own experience, products from the best Taiwanese factories are excellent – and the equal of those made almost anywhere. But I have to admit that those from the lower end of the scale are roughly the equal of the worst I've ever seen, too.

My own advice would be not to beware of all products from Taiwan, but to check ALL components you buy carefully – and either reject or return promptly any duds, for replacement or a refund. That's the only way we'll get the suppliers to lift their game.

Exactly what basis some of the suppliers use to decide which parts they will stock, I don't know. But I suspect it's closely related to buying volumes and trends, as I suggested in the March column. Nowadays, with interest rates moving ever higher, few firms can afford to stock all lines on the off-chance that customers may want them from time to time.

The days of the supplier who stocked 'everything' are probably over, I'm afraid. And the same is rapidly occurring with the old type of knowledgeable sales assistants, who could help you with technical advice. There are still some around, but they're getting scarcer – again for economic reasons, I suspect.

Finally, I note your comments about the supposed 'end of the electronics era', and the need for a local magazine like *Byte*, catering specifically for computer hackers. However I think you may be influenced a little too much by your own interests in this area.

Personally I believe the 'electronics era' is far from over, and is still likely to be with us for decades to come. In fact there seems to be more to write about, and more interesting and useful potential construction projects than ever before!

Although computers have indeed become an integral part of electronics, and are becoming more and more at the core of many items of equipment, there is still a big place for 'conventional' analog and hard-wired digital circuitry – and in my view this will remain the case for a long time to come.

As for *EA*, I see our role as covering as many areas of electronics as possible – including computers and their interfacing, but certainly not to the exclusion of conventional electronics. In fact I suspect that in the future we're going to have to help a lot of our readers keep up with the conventional side of electronics, and analog electronics in particular, because of the way this side seems to be becoming the less glamorous 'Cinderella' area, and somehow getting less emphasis in the colleges and university courses.

It's not easy to find the correct balance between 'programmed' and 'hard wired' electronics, to be sure, but frankly I'm convinced that this is the course that a magazine like *EA* must take if it is to continue to be of real value to our readers.

Specialised magazines like *Byte* serve a very worthwhile purpose, of course, although I'm not at all sure that the much smaller Australian market is capable of supporting local equivalents. Over here, you seem to have to appeal to at least a reasonable number of different reader groups, in order to survive.

So I'm sorry, Peter (and perhaps quite a few others), you're not likely to see us turn into a *Byte* clone. We will be carrying quite a bit of material on using computers in electronics, and in interfacing them to other circuitry – because if we didn't, we wouldn't be keeping ourselves and our readers up to date. But it won't be at the exclusion of other important aspects of electronics, such as audio, video, RF and 'hard-wired' digital circuitry. To ignore these would also be letting our readers down, because modern electronics includes them all.

As usual, folks, if you think I'm wrong please write in and let me know. I hope you'll join me next month.

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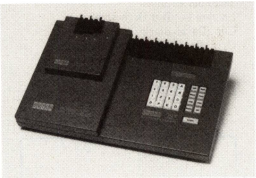

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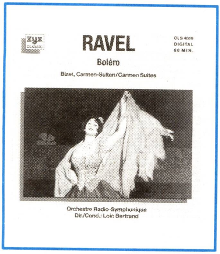
Compact Disc Reviews

by RON COOPER

RAVEL


zyx CLASSIC
RAVEL
CLS 4019 DIGITAL 60 MIN.
Boléro
Bizet, Carmen-Suiten/Carmen Suites
Orchestre Radio-Symphonique
Dir./Cond.: Loic Bertrand

Maurice Ravel (Bolero)
Georges Bizet (Carmen Suites)
Orchestre Radio-Symphonique
ZYX Classic: CLS 4019 DDD
Playing time: 60 min

PERFORMANCE
1 2 3 4 5 6 7 8 9 10
██████

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10
██████

Ravel's 'Bolero' is an evergreen if ever there was one, although I suspect that most people either love it or hate it.

Bolero was first performed in 1928 at the Paris Opera. This version, like most others, should be played in the dark and given total concentration. Although there are differences in the musical interpretation, compared to other versions, this one is very good and has a sound quality to match.

From the cover note, this all-digital version is played by a different orchestra and conductor to the other works on this disc, and I assume a different recording technique or studio as the sound balance is quite different from the Bizet works – which I found quite disappointing.

The sound on these tracks is blurred, with poor bass. I also found difficulty adjusting to the interpretations.

At $9.90 it is an expensive Bolero, which on its own would rate around 8/8; but overall I cannot recommend this one.

MOZART/BEETHOVEN

Classical overtures
London Festival Orchestra
Con.: Kurt Redel
London Philharmonic Orchestra
Con.:Alfred Scholz
ZYX Classics: CLS 4006 DDD
Playing time: 64 min

PERFORMANCE
1 2 3 4 5 6 7 8 9 10
███████

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10
██████

This disc contains an excellent selection of popular tuneful overtunes, all of which have instant appeal. They are:

Beethoven – The Creatures of Prometheus; Fidelio; Egmont; Leonore No.3; Coriolan; and Mozart – The Abduction from the Seraglio; The Magic Flute; Le Nozze di Figaro; La Clemanza di Tito.

Originally the operatic overture was a kind of muscial synopsis of the following opera, and provided background music to the audience conversation before the curtain rose. In many instances the overture has remained in the musical repertoire, while the opera itself disappeared.

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MOZART
BEETHOVEN
CLS 4006 DIGITAL 64 MIN.
Klassische Ouvertüren / Classical Overtures
Die Entführung aus dem Serail, Die Zauberflöte, Figaros Hochzeit
Die Geschöpfe des Prometheus, Fidelio, Egmont, Leonore, Coriolan
London Festival Orchestra, Dir./Cond.: Kurt Redel
London Philharmonic Orchestra, Dir./Cond.: Alfred Scholz

Generally, operatic overtures are very tuneful, rythmic, and those here are no exception. If you are just venturing into classical music, don't be put off by the rather lengthy titles.

The performances on this disc are good, but not spectacular. Also some of the tempos are not quite the usual, but this is less likely to concern those unfamiliar with these works. They are still very good to listen to.

On the technical side, the miking and acoustics could have been a lot better, but it is still worth the price of $9.90 – even though it is below the standard of say Philips or Telarc.

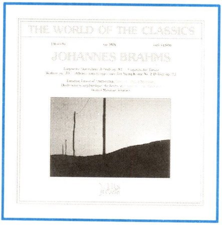
BRAHMS

Johannes Brahms
London Festival Orchestra
Con.:David Blackside
Orchestre Symphonique du Festival
Con.: Loic Bertrand
VMK Globe: 100.41806 DDD
Playing time: 60 min

PERFORMANCE
1 2 3 4 5 6 7 8 9 10
████████

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10
███████

This is a budget price CD, which I would regard as an excellent way of getting to know this great composer's music – if you are unfamiliar with it.



However, I could not recommend this disc for devotees of Brahms, mainly because of the inclusion of only part of the famous second Symphony. A much better choice would have been the Academic Festival Overture – another great piece, but complete in its own right.

The playing throughout this disc is very good and most will recognise the colourful Hungarian dances – and the waltzes which are skillfully played on the piano by Isabel Mourao – (waltzes only)

The recording quality is also very good and they appear to be modern all-digital versions. The acoustics are not what I call ideal though, and tend to mask an otherwise fine recording. But it is still an excellent way to become acquainted with this great music.

If you're a budding Alexander Graham Bell we'd like you to...well... give us a bell.

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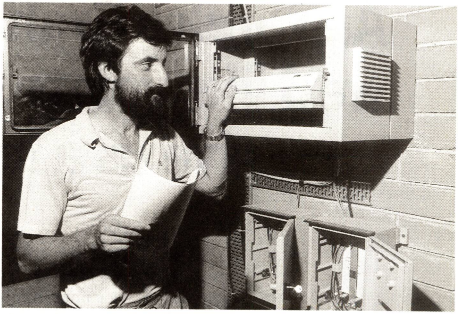
News Highlights

LaTrobe Uni 'lassoed' with FO cable

An optical fibre 'lasso' has been thrown around the LaTrobe University campus in Melbourne, as part of a major upgrade of the institution's networking capability. Twin six-fibre optical cables have been looped around the campus linking Ethernet backbones to about 100 individual locations, said Network Manager Phil County.

Mr County, who also lectures in computer science at the University, custom designed the system using several kilometres of optical fibre cables manufactured by MM Cables in Melbourne. The twin cables, mounted in trays, travel in opposite directions around the perimeter of the LaTrobe campus.

"LaTrobe University is quite a compact campus, and is fortunate to have a large number of subterranean walk-through tunnels," he said. "The O/F cables have been laid in trays mounted on the walls of the tunnels. They share the tunnel space with quite a few other University services, such as hot water reticulation and telecommunications cables.



"So far, we have got about 100 Ethernet segments running off the optical fibre, with termination points on every floor of each building on campus."

Overseas sales for local development

Teletech, of Vermont (Victoria), with the assistance of the Telecom Australia Product Development Fund, has recently completed the design and manufacture of a novel test instrument known as 'Loop-a-Line'. Already 250 orders have been received from Telecom, New Zealand and other overseas telecommunications companies and administrations are known to be actively assessing the new equipment.

The equipment, which is used by technical staff to assist in the identification, location and repair of faults on telecommunications cable pairs, is the result of two years work by the company. In particular Roger La Salle, the manager of Teletech, has been responsible for the conception and design of the instrument.

The product was initiated in 1987 when Teletech approached Telecom for support. At that time Telecom had just announced the existence of its Product Development Fund aimed at helping Australian companies develop new and innovative telecommunications oriented products. This fund was the ideal mechanism for such a product and substantial financial support was approved enabling the development to take place. In addition the continuing liaison with Telecom staff allowed the designers to seek opinions and advice from people who were potentially significant customers for the final product.

The success of the 'Loop-a-Line' in the short time it has been released indicates that earlier market predictions were correct and that the Australian company has produced a world leader in its field.

International flavour to IREECON '89

IREECON '89, the 22nd International Electronics Convention and Exhibition organised by The Institution of Radio and Electronics Engineers Australia, will highlight the extent to which this major Australian event has also acquired an international flavour.

Among the exhibitors will be a large delegation from West Germany while the convention's keynote speaker will be a world-renowned Amercian in the

CSIRO Institute Director calls for Victorian supercomputer

Dr Colin Adam, Director of CSIRO's Institute of Industrial Technologies, has called on the Victorian Government to invest its Strategic Research Fund in new equipment for existing research facilities.

The Cain Government has earmarked a minimum of $33 million to this fund over 5 years to identify new areas of strategic research significance.

Addressing the Victorian Science and Industry Forum, Dr Adam said that

Landsat reveals geological faults

Several previously unknown geological faults, some of which may be active, have been discovered in the central and eastern Mojave Desert in California by geologists at NASA's Jet Propulsion Laboratory (JPL), Pasadena, California, and Louisiana State University analysing images from an Earth-orbiting Landsat satellite.

The strike-slip faults were identified by images taken by the 'Thematic Mapper' instrument on Landsat 5, which obtains images simultaneously in seven bands at optical and infrared wavelengths. Scientists used the TM images as a 'map' which pointed them in the right direction to locate and confirm the faults in the field.

JPL's Dr John Ford, who helped locate and verify the faults in the field, said that "without Thematic Mapper images we would not have found the faults and TM images may enable us to find many more unmapped faults in the Mojave."

Kambrook making computers

The Kambrook Group of companies has announced its entry into the high-tech world of computers and information electronics, with the stated objective to become Australia's largest computer manufacturer.

Already a household name for its domestic electrical goods, the 25 year old company announced its move into computers following two years of investigation, installation of new manufacturing equipment and plant, and a test marketing phase.

As well as microcomputers, the company's new Office Automation division will sell a wide range of peripheral equipment including computer monitors, laser printers, electronic scanning devices and communications equipment such as modems, facsimile systems, phone and answering machines.

Kambrook's founder and Chief Executive, Mr Frank Bannigan, said the transition was a logical one, as many of the company's household products already incorporated electronic components.

"Kambrook is starting with a broad manufacturing base, and with established expertise in production line techniques in electrical and electronic equipment" he said.

"By November last year, we had established our AT-style (80286) personal computer assembly line and began manufacture of 80386 computers the following month specifically to meet the needs of a Federal contract brought in during our test marketing phase" the Kambrook CEO said.

"By Christmas 1989, we will have invoiced our 5000th Kambrook computer and believe we will, by then, be the largest Australian owned manufacturer of personal computers," he added.

forefront of telecommunications research, Dr Irwin Dorros, Executive Vice President – Technical Services of Bell Communications Research (Bellcore).

IREECON '89 will be held at the Royal Exhibition Building in Melbourne from September 11 to 15. (The site alternates between Melbourne and Sydney, which hosted IREECON '87.) The biennial event, which had its beginnings before World War II, is now the largest professional electronics exhibition and convention in the Southern Hemisphere.

CSIRO picks Triune as partner for GaAs development

The Minister for Science Customs and Small Business, the Hon Barry Jones, has announced that CSIRO was working with an industrial partner on the commercialisation of its gallium arsenide device technology. The preferred partner, Triune Pty Ltd, an Adelaide-based company, was chosen after a call for expressions of interest. Detailed arrangements are expected to be finalised over the next few months.

"Demand for increased computing power and communications bandwidth is beginning to exceed the capacity of silicon-based micro-electronics," Mr Jones said. "Gallium arsenide technology is set to out-perform silicon-based semiconductors. It is overtaking silicon-based devices in terms of noise, switching speed, frequency of operation, power consumption and the achievement of advanced integrated circuits."

"There is a lot of interest in the use of gallium arsenide devices in radio, satellite and optoelectronic communications, navigation, instrumentation and surveillance electronics. At the moment gallium arsenide devices have less than 10% share of the world market for these applications, so there's a good opportunity for Australian developments in this field."

CSIRO now has a team of twenty working on gallium arsenide technology, and the organisation has so far expended $7 million on the program. "CSIRO has been working on this technology for over seven years," said Mr Jones, "and now it is at a stage where commercial developments can be undertaken. CSIRO and Triune see major growth options in optoelectronics, including integration of these with gallium arsenide devices."

devoting the Strategic Research Fund to establishing new research institutes would be counterproductive. He said four of the five areas to be considered by the Strategic Research Fund Board – Biomolecular Research, Agricultural Biotechnology, Climate Science, & Materials Science – are already strongly represented in Victoria by CSIRO. (the fifth area is Fifth Generation Software).

Dr Adam said that Victoria needed world-class facilities to best capitalise on existing advantages in the field of scientific and technological research.

"Victoria has excellent educational facilities, fundamentally sound research organisations and world-class scientific staff. A great need exists for venture capital, state-of-the-art equipment and brillant, highly motivated young people to provide for 21st century growth," Dr Adam said.

As an example of the need for up-to-date equipment Dr Adam highlighted the lack of supercomputer access for Victorian researchers. He compared this with facilities available in the US states of North Carolina, Delaware, Ohio and Alabama where supercomputer facilities have attracted corporate support and new manufacturing ventures.

Dr Adam said a Victorian Supercomputer Facility could be established for about $6.5 million per year. He said this would enable a staff of 25 to be employed on the project.

Microwave industry proposed for Australia

Philips is proposing to setup in Australia a manufacturing activity to produce advanced microwave systems, for civil and defence communications applications. This Philips business plan is riding on the back of the proposal for the ANZAC Frigate Program submitted by MEL, the UK defence electronics company of the Philips Group.

The Australian and New Zealand in-country involvement package offered by MEL includes the setting up of a microwave facility in Australia, rights for in-country manufacture, support and marketing from Philips Australia for both home and export. The package also contains a significant New Zealand element.

This technology, wholly owned by MEL, will have applicatons in the electronic warfare, radar, navigation and military guidance systems areas. It also has a wide variety of civil applications pertinent to telecommunications, business systems and medical equipment.

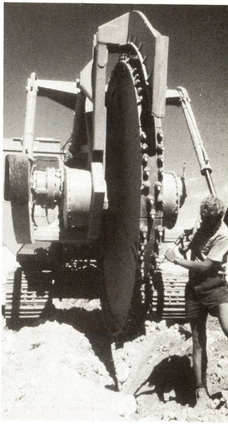
John Burrows, Director of MEL's Electronic Warfare Division, has completed a series of discussions in Australia, New Zealand and with the local representative, Philips Defence Systems. "Our proposal is to transfer the technology and establish the production of advanced microwave communications components at Philips Microelectronics Centre in South Australia," said John Burrows. "The assembly, development and testing of full systems will be undertaken at Philips Defence Systems plant, Moorebank, NSW."

$32 million Darwin-Adelaide fibre-optic link opened

One of Australia's most ambitious and expensive communications projects drew to a close recently on a small rural property near Gawler, north of Adelaide, when the final connection was made to Telecom's North-South optical fibre communication line. The 2,396 kilometre line has taken three and a half years to complete, at a cost of $32 million dollars.

It's been one of the biggest optical fibre laying jobs in the world – second only to the East-West line, which will be complete later this year.

The line links Adelaide to Darwin and is optical fibre all the way except for a 655 kilometre section between Katherine and Tennant Creek in the Northern Territory, which is serviced by the Digital Radio link. It is a major part of Telecom's commitment to link all Australian capital cities with the high powered optical fibre, which permits the rapid transmission of vast amounts of TV, data, phone and fax transmissions.



Ericsson signs export agreement with China

Ericsson Australia has signed the nation's first major long term export agreement with mainland China. The multi-million dollar agreement was signed recently between Ericsson and the Ningbo Post & Telecommunications Bureau, the Ningbo Telephone Company and the China National Instruments Import/Export Corporation.

The agreement covers AXE public telecommunications exchange switching equipment. Ericsson is confident that it will lead to sales of 120,000 telephone lines to a value of more than US$30 million.

The agreement is the largest telecommunications contract to be signed by an Australian company with mainland China to date.

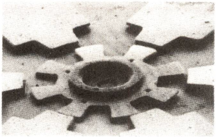
Microscopic motors developed

Electrically powered microscopic motors, no larger than the width of a human hair, have been assembled and successfully tested for the first time by researchers at the University of California, Berkeley.

The micromotors were made using the techniques and materials of semiconductor manufacturing, demonstrating the possiblity of mass producing micromachines integrated with microelectronics.

Potential applications include medical and microsurgical equipment, scientific instruments, manufacturing equipment and consumer products.

The new development is the work of Richard S Muller, professor of electrical engineering and computer sciences at Berkeley, and his graduate students Long-Sheng Fan and Yu-Chong Tai.



The electrically powered motors produced by the Berkeley researchers follow successes last year using the same technology to produce microscopic cranks, gears, springs, sliding parts and other devices capable of mechanical movement.

The new motors are about three-thousandths of an inch in diameter, with notched teeth about the size of red blood cells.

They require extraordinarily low amounts of current. Rough estimates, which don't yet take friction into account, indicate that between a million and a billion of these motors together would consume the current used by an electric pencil eraser.

The motors have been made to demonstrate the feasibility of the fabrication process, and although they move under electrical power they do not yet perform practical functions.

Prime Minister opens new AWA Microelectronics plant

Prime Minister Bob Hawke has offically opened the new AWA MicroElectronics plant at Homebush, in Sydney's west. The new facility is the first in Australia to be able to design and manufacture Application Specific Integrated Circuits (ASICs) and provides an essential element in the continued development of Australia's high technology electronics industry.

AWA regards the commissioning of the Homebush Bay facility as an important step in its 'Silicon Initiative', which includes the recently launched network of ASIC Technology Centres Australia wide.

One of the key features of the plant is the highly sophisticated $3 million clean room where the silicon wafers are made. The new clean room has been given a Class 10 rating, but approaches a Class 1 rating, meaning that no more than one particle of 0.5 micron diameter exists per cubic foot of air in the room.

One of the first jobs for AWAM's new world class facility will be to build one of the largest microchips in the world – a new mega-microchip for the Overseas Telecommunications Commission Australia (OTC).

The mega chip is a new signal processing chip designed to reduce interference or noise during international communications by OTC. It will comprise the equivalent of around 100,000 transistors – by far the largest microchip to be designed and manufactured in Australia.

News Briefs

- Melbourne-based switch-mode power supply maker **Setec** has qualified as a supplier to international computer manufacturer Unisys, and based on that company's current procurement plans looks like exporting $1 million worth of power supplies to Spain for assembly in Unisys B25 workstations.
- ***Advanced Solutions*** of Sydney has been appointed Australian distributor for the printed circuit board CAD software range of Design Computation, based in New Jersey, USA. The company has also been appointed exclusive distributor for Swedish switching power module maker Lindmark Electric AB.
- Melbourne engineer-journalist Athol Yates has established a new firm, ***PAS Technical Writing***, to specialise in providing technical writing services for engineering firms. Athol can be contacted at 82 Wellington Street, Richmond 3121, or phone (03) 429 9272.
- Michael Foletti has been appointed national product manager at ***Amtex Electronics***, with responsibility for the firm's range of video printers.
- ***Macquarie University Materials Physics Centre*** and ***Plessey Australia*** have been awarded a New Materials Generic Technology Grant of $254,800 for the investigation of composite high-temperature superconducting devices for IR imaging and microwave detectors.
- US professional audio manufacturer Benchmark Media System Inc has appointed ***Dynamic Sound & Vision*** (part of the Andrew Sweeney Electronics Group) as exclusive distributor of its products for the broadcast and recording industries.
- Cable maker ***MM Cables*** has made a number of new appointments. John Parsons is now Product Manager, Power Distribution, Frank Halim Marketing Manager, and Kam Yang Engineering Manager for Pyrotenax in Melbourne; while Paul Harris is Manager, Electronic and Data Cables in Liverpool, Sydney.
- US computer networking specialist Broadband Networks Inc has appointed local firm ***Broadband Networks Communications*** (part of the Andrew Sweeney Electronics Group) as its exclusive distributor for the Australian and South-East Asian areas. BNI has developed a new 'star topology' broadband system that is creating a lot of interest in data comms circles.
- ***Datacraft Australia*** has appointed David Tulloh, formerly with J.N. Almgren, as its NSW Sales Manager.
- Perth-based supplier of specialised power-electronic and electrical equipment to the resources industry, ***J.T. Day & Co*** has merged with ***SAB NIFE***, local branch of the Swedish battery, power electronics and railway brake equipment maker. John Day has been appointed Managing Director, and David Williams Technical Director.

Telecom & Siemens develop protocol tester

A development project funded by Siemens and Telecom Australia, and undertaken jointly at Telecom's Research Laboratories (Clayton, Vic) has created an important new platform to world telecommunications markets.

Dr Friedrich Thon, Senior Director of Instrumentation Development at Siemens in Berlin, was recently in Australia to sign an agreement which marked the successful end to the development work, whose outcome is likely to figure prominently in many major future developments in telecommunications services. This agreement covers the development of specialised software for high-level protocol testing.

Because today's communications systems are becoming more and more sophisticated, the complex protocols supporting them can be prone to design and operational errors. It was with the aim of detecting those errors, and simplifying life for both the communications equipment supplier and the end user, in Australia and internationally, that Telecom and Siemens launched the protocol tester software development program over 2 years ago with Siemens.

According to Dr Thon, the protocol tester has already been welcomed in overseas markets, since it has been designed for easy modification to suit specific national requirements.

The Serviceman

In organs and computers, minor faults can often cause major hassles!

If you think you've had problems getting the family VCR or TV set fixed, spare a thought for a church organist suddenly faced with an instrument that doesn't want to make music; or a freelance writer whose computer stubbornly refuses to read its own discs! People in such situations are likely to turn for help to their friendly local serviceman!

In recounting this story, I should perhaps emphasise that I normally try to steer clear of electronic organs and even more so of computers. I'm interested in them, for sure, and try to keep track of trends and developments, but it's quite another matter to get involved in repairing them on a regular basis. Or for that matter, even on an occasional basis.

For that, a serviceman needs appropriate test equipment, accreditation, manuals, access to spare parts and the opportunity to acquire a good working knowledge of brands and models. Otherwise, he'll muddle through, at best, spending far too much time identifying and correcting faults – and risk ending up in the red!

On the other hand, what can a serviceman do when a family friend, a church organist, rings up in near despair to say that the organ has failed and that they need it desperately for special services on the coming Sunday?

The repairman who had been looking after it was now otherwise employed, he said, and the person he had nominated to take his place had moved to the country. They hadn't been able to locate anyone else to do the job, so could I please help, this once...

The best I could promise was that, if it proved to be a simple fault, easy to find and to fix, I'd help out – but not if it involved setting aside other urgent committments for a major exercise.

It was at least encouraging to be assured that the fault involved only the bass pedals, which were producing rumbling noises rather than musical notes. Everything else seemed to be okay. Yes, my organist friend had a copy of the circuit which he would bring along.

When I met him at the church on the following afternoon, it was to discover that the instrument was an Italian-built model 150 Gem, a series later renamed Viscount. From the much-copied and now barely legible circuit, dated 1970, I observed that it used germanium PNP transistors throughout, with a negative supply rail.

A spinet model, it had the usual 17 or so monophonic bass pedals and my friend quickly demonstrated that, at best, the notes from bottom-C to G-sharp played spasmodically; the A was hopeless, and the remainder totally erratic. Holding a note down for any length of time usually resulted in a random rumble.

Switches? Gates? Muting?

I had no intention – even subsequently – of spending valuable time trying to fathom out the workings of a visually and electronically obscure circuit, but it was obvious enough that the bass signals were derived from the master oscillators, via transistor gates actuated by the respective pedals (Fig.1).

The selected signal then passed through a multi-stage voltage amplifier to a switchable 'sustain' circuit and thence to flip-flop dividers and buffer amplifiers to provide selectable 4ft, 8ft and 16ft pedal voices. All told, the parts count on the 'Pedal Sustain, Gate Circuit' board would have added up to a couple of dozen transistors and more than 100 resistors, plus sundry capacitors and diodes.

I could only express to my organist friend the fervent hope that the problem was in the pedal switch contacts, which were reasonably accessible once we had swung the Leslie loudspeaker assembly out of the way. If the trouble was in the circuit board, mounted on the rear of the main baffle, with wires running hither and yon, there could be little hope of a quick find-and-fix.

The pedal contacts, involving what appeared to be gold-plated spring wire, were effectively single-pole double-throw switches with a follow-through action. The trouble was that after 15-odd years of hard work – and probable tampering – it was difficult to decide exactly how they were supposed to be set. Right then, some looked as if all three wires were already touching!

In the at-rest position, according to the circuit, the switches were supposed to form a simple series chain which applied what was apparently a muting voltage to the buffer amplifiers. Pressing any one pedal broke the muting chain and, at the same time, opened a 'gate' to admit the selected bass note, which then sounded.

On this basis, I began to work my way systematically along the pedal switches from bottom-C up, bending and tensioning the wires to ensure reliable muting with the particular pedal in the at-rest position.

This done, I re-set the third wire so that the gating circuit would close, as the pedal was depressed, just before the muting contact was broken – in other words, a make before break action. (Fortunately, in this organ, the pedal contacts could be manipulated from the rear by hand, making the job much easier).

After each adjustment, I cleaned the contact area of the wires with a small brush dipped in WD-40, producing a reassuring golden glitter.

A single dry joint!

All went well until I reached the A-pedal, where the at-rest contact rewarded my attempts at tensioning by rotating in the eyelet into which it was soldered – a classic dry joint. It may or may not have been electrically intermittent, but it certainly compromised the tensioning and, with it, the entire series muting circuit. The wire had to be be withdrawn, re-tinned and re-positioned.

This done, and the remaining contacts adjusted, I was rewarded with pedals that played the right notes, without rumble or grumble. How much of the trouble had been due to wrongly set

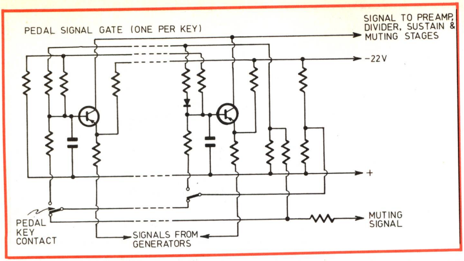

PEDAL SIGNAL GATE (ONE PER KEY)
SIGNAL TO PREAMP, DIVIDER, SUSTAIN & MUTING STAGES
-22V
+
MUTING SIGNAL
PEDAL KEY CONTACT
SIGNALS FROM GENERATORS

***Fig.1:** A single dry joint and incorrect tensioning of the spring wire pedal switches was sufficient to cripple an otherwise serviceable electronic organ.*

wires and how much to the insecure muting contact I shall never know but, while relieved that the immediate problem had been fixed, I was uneasy at what I had to leave behind.

Just before packing up, I had run the multimeter along what appeared to be symmetrical networks on the PC board and found as much as a 2:1 discrepancy in the voltages. The differences may have been incidental to the associated transistors, but they could equally have indicated substantial drifts in the value of the hundred or more resistors.

After 15-odd years of service, the instrument had probably reached a stage where it was in desparate need of some TLC (tender loving care) – an unhurried, methodical board-by-board check for suspect components, contacts and solder joints, along with an inspection of the key and tab contacts and wiring, amplifier(s), reverb system and the rest.

Whether that kind of restorative maintenance can be handled economically by a professional repairman is another matter, but it would certainly be within the capacity of a mature technician/member, prepared to get to know the instrument and adopt it as a 'sacred' responsibility.

I've heard of quite a few modest pipe organs around the place that are maintained by handymen/members willing to turn their skills, under supervision, to woodwork, metalwork, leatherwork and basic electrics. Ageing but still serviceable electronic organs may need the same sort of support, I suspect.

A fitting sequel

As if to lend weight to that last observation, and by way of further interest, I received a phone call from a church member a few days later which is well worth a mention in this context. He thanked me for my timely assistance during the previous week, and went on to suggest that I might be interested in an earlier episode involving a bass pedal on the same organ.

Apparently it had collapsed during a service, sagging limply towards the floor instead of returning to its normal at-rest position. Not only was it silent, itself, but other pedals seemed to have been affected.

Because it looked like a mechanical problem, and he was a retired fitter with a modest home workshop, the organist had asked him to have a look-see at what had apparently broken or come adrift.

To get at the pedal mechanism, they had to unscrew the back panel of the instrument and also to prop up the pedal end of the console on a nearby chair. This done, it didn't take long to establish that a flat spring-steel strip supporting the faulty pedal had broken and would need to be replaced.

It was easy to say, but where does a home handyman (or a serviceman, for that matter!) get a lone piece of spring steel strip of the right gauge, measuring about 11 x 2cm? It was while searching for inspiration around his workshop that my caller spied a couple of discarded mower blades.

Sure enough, he said, a visit to the local hardware store brought to light a set of (he thought) PACE blades of exactly the right thickness and long enough to be reduced to the required size.

"But how on earth would you manage that", I asked. "Those blades are as hard as sin and, if you heated them, you'd lose the temper?"

Obviously, however, old-time fitters also know a few tricks, as revealed by the rest of the conversation. With chalk and pencil, he'd marked off the required 2cm width and then carefully clamped the blade in a large bench vice, with the surplus exposed. After scoring along both sides, against the jaws, a few firm sideswipes with a hammer had parted the surplus "as clean as a whistle".

After lightly dressing the new edge on a grinding wheel, the same technique was used to reduce the length to the required 11cm. (Or was it the other way around?)

To drill the two pairs of holes required, the broken spring was clamped carefully into the vice, along with the new piece, to act as a template. The new blade was certainly hard, he said, but by using plenty of pressure and resharpening the bits before they became blunt, the holes were drilled without too much bother.

That done, the pedal was re-installed – a job that needed an extra pair of hands. While he was curled up on the carpet at the front of the up-ended console driving the screws (the easy job?) it fell to the organist to fiddle the nuts and washers on the other end.

Being a purely mechanical task, the then-regular serviceman did not need to be involved – a situation that, I imagine, concerned him not in the least! On the other hand, I also imagine that the aforesaid member-fitter will be on call as chief pedal fixer for as long as he and/or the organ are around!

A computer problem

The other friend who contributed unwittingly to this story is a freelance writer and, for good measure, the kind of 'willing horse' who regularly cops 'Hon. Sec.' type jobs for voluntary organisations.

A few years back, he decided to invest in a personal computer, mainly to use as a word processor. His choice fell on the Apple IIc, which was compact, affordable and well supported in terms of service and software.

Along with it, he bought a modest printer and interface, a packet of Dysan floppy discs and the 'Appleworks' integrated software package – combining a word processing program, with database and spreadsheet, and with built-in 'Pinpointer', providing communication and other facilities.

He was as happy as the proverbial Larry, although he did mention, on one occasion, that his IIc seemed to be rather more compatible with the Dysan discs than with a couple of the other brands he had since tried.

But recently, when I called by, I found him as miserable as only a computer freak can be when his pride and joy starts to act up. Said he: "You're just the man I want to see!"

It seems that, a few days previously, his computer had begun to display erratically on-screen messages like 'Getting errors when reading disc', 'Try again', or 'Formatting' followed by a puzzling 'Can't find the disc'!

If things got any worse, he said, he mightn't be able to save new work at all or access the old – a daunting prospect, as any computer user will testify.

He began to wonder whether the read/write head needed cleaning, although against this, he had to admit that the computer never seemed to have any problem reading the program discs.

Contacted on the phone, an Apple technician expressed doubts about the dirty head theory, along with reservations about advertised head cleaning discs. He could check and clean the head pretty smartly in the workshop, but the caller should be warned that there was a $45 minimum charge for all service work.

The technician wasn't too surprised that some discs seemed better than others. Certain brands, he felt, weren't as good as they were cracked up to be.

What if the problem proved more deep seated, my friend asked. What kind of money might he be up for, if parts had to be replaced? Could it reach a level where the expenditure might not be warranted?

"It could be $50, $100, $150 – anything", the technician said, "depending on what's wrong – whether it's in the digital or analog section". Fortunately, his company carried replacement boards and parts in stock and, if so requested, they could give a firm quote before proceeding with the job.

My friend recounted this conversation and demonstrated his problem during the course of my visit. There the matter might have rested, except for one thing: the technician's reference to 'digital' and 'analog'.

I was sufficiently intrigued, next morning, to ring an engineer friend who knows a lot more about computers than I do. He suggested, readily enough, that the reference to 'analog' probably had to do with the disc drive's record/replay function.

"Although it's digital data", he said, "if you've seen on a CRO what actually is impressed and recovered from magnetic tape or disc, you'd realise how close it gets to analog technology".

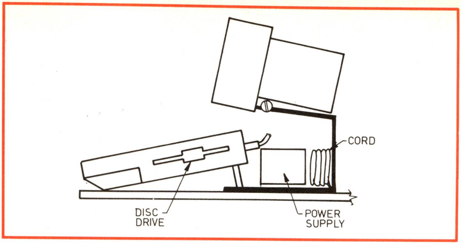


Fig.2: What looked like a major fault in the floppy disc system of an Apple IIc computer was caused by positioning the power supply in the most inviting place – tucked away inside the monitor stand, just behind the computer.

As a matter of fact, I had. And then the penny dropped – or was it one of those new $2 coins? That same evening I rang my friend, the Apple owner, and recounted the above conversation.

"As hifi enthusiasts from wayback", I asked, "would either of us deliberately put a power supply alongside a pickup or tape head? No, we wouldn't? And yet, as I remember it, you've got the power supply of your IIc as about as close as you can get to the back of the computer and the built-in disc drive. What if it's radiating a 50Hz field or some form of high frequency hash?"

My friend rang back next day to say that, prompted by my remark on the previous evening, he'd since been through a long and productive exercise.

He'd realised that, about the time his troubles had started, he'd tidied up some of the cables connecting this to that, tucking one of them into the monitor stand behind where he had the power supply, thereby pushing it much closer to the computer. (Fig.2)

That's where it was when I had seen it, on the previous evening. However, he said, he did on occasions pull the computer forward a couple of inches, which would have increased the distance between the two – a likely explanation for the seemingly erratic behaviour.

He had now placed the power supply not just where it had originally been, but right out of the way on the equipment shelf under the table. And thankfully, the computer was now behaving normally.

He had been able to format new discs without problems and had transferred data to them from those that had previously been difficult to read. The suspect discs, in turn, had been re-formatted without further hassle!

His last act, before crawling into bed, had been to check through the manuals that came with the computer to see whether they included a warning about placing the power supply in what was physically a very natural position. But he could find not a word to that effect.

Just before ringing me, he had talked again with the Apple technician. "Ah yes", came the reply. "Now that you mention it, I do seem to remember a circular from Apple recommending that the power supply be kept well away from the computer proper".

I leave it to the experts, if they wish, to interpret all this but, to me, it has the hallmarks of a classic signal/noise problem.

My guess is that radiation from the power supply was affecting both the recording ('writing') and reading processes. The computer could always read the clean program discs but, on discs that it had formatted or over-written itself, the ultimate signal/noise ratio was such as to render the signal only marginally readable.

As for the apparent difference between the various discs, I can only suggest equally marginal differences in their characteristics which became evident in these circumstances.

At this stage, I doubt that my friend greatly cares. More to the point is his observation that, had he taken the computer back for a check-up, it would have cost him at least $45 to be assured – quite genuinely – that there was nothing wrong with it!

I wonder how many other Apple IIc's are out there, with their power supplies tucked neatly into that inviting, vacant space in the monitor stand?

Closer to home...

At the beginning of this story, I mentioned that I tried not to get involved with repairing organs and computers. This even extends to my own computer, which has a niggling little problem – one that I have succeeded in avoiding for six months or more.

I fitted an expansion board which gives me 128K of extra RAM which can be battery backed, except that I couldn't get one with a battery already fitted. The board had its charging facility installed – it only lacked the PCB mounting NiCad.

The battery was easily obtainable from another source and was just as easily fitted. It charges up without trouble, and it keeps the required 2-3 volts on the RAM chips, for days and days after the power is turned off.

The trouble is that the chips won't retain the data in memory for more than an hour or so. The battery is properly fitted, the voltages are more or less normal, yet the board won't hold its data.

Battery backed memory wasn't one of the features that persuaded me to buy this particular board. It's a facility that I have no immediate use for, so fixing the apparent fault would be something of a waste of time.

And without access to both the computer service manual and the expansion board circuit diagrams, there's not much hope of easily finding the reason why my computer so quickly forgets its lessons. (Anyway, that's my excuse and I'm going to stick to it!)

Next month we'll be back on more familiar territory. Won't you join me? EA

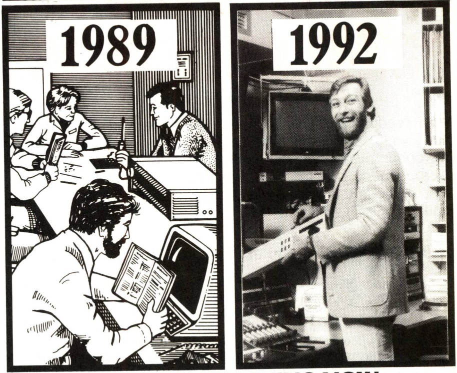
Fault of the Month

Kriesler 59-03

SYMPTOM: Irregular flashing lines across screen, shaky verticals, sometimes weaving verticals like a very fast hum bar. Intermittent small change in picture size.

CURE: Part of the trouble was a dry joint at R755, across the horizontal linearity coil. The complete cure required the replacement of the high voltage tripler which had developed an intermittent drop in efficiency.

This information is supplied by courtesy of the Tasmanian branch of The Electronic Technicians' Institute of Australia. Contributions should be sent to J.Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.



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ALA/ST6820/EA589

Construction Project:

An improved FM radio microphone

Most readers probably own an FM radio and an amplifier. Now you can combine them with this high quality FM microphone and give yourself a wireless PA system. The microphone is fully featured, easy to construct and tune, with specifications that rival professional models – and all for less than $40.

by BRANCO JUSTIC and JEFF MONEGAL

The FM microphone is now fairly common, and many PA systems include a channel devoted to such a device. The concept is very simple – an FM receiver module connected to the amplifier, with a portable FM transmitter as the microphone. In practice, the quality of the whole system depends heavily on the microphone/transmitter combination, and cheap units are usually not worth the trouble.

The main problems are maintaining a stable transmitting frequency against changes in battery voltage, and tailoring the audio section to give the required pre-emphasis prior to transmission. This is easily achieved in a fixed system, but when the whole thing needs to fit into a handheld microphone, things become a bit more tricky. Often, the approach adopted is to leave out these sections, and hope for the best.

The performance of our new self-contained FM wireless microphone compares favourably to that of good quality professional radio microphones. However the 'Radiomike' can be made for a fraction of the price of the commercial units and the complete kit is available from Oatley Electronics for only $37.95.

Why an FM mike?

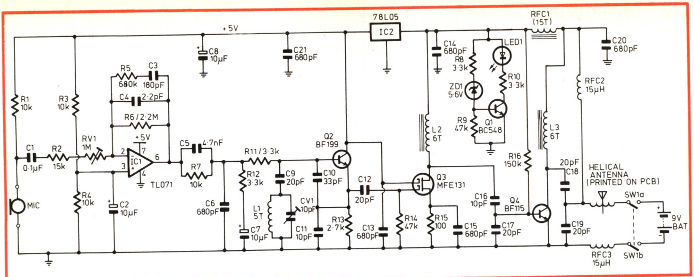
The attraction of an FM mike is mainly its portability, as a connecting lead is not required. This allows a performer to wander freely around the audience, or to be positioned some considerable distance from the PA system. This latter feature is ideal for outside use, where the cost of a long length of shielded cable may start to become expensive as well as awkward.

Another feature is being able to feed a number of amplifiers from the one microphone. As FM radios are almost as common as mud, it is quite possible to have the same FM microphone feed a number of receivers. For example, a 'ghetto blaster' system might be used to record the event, another system(receiver/PA) to amplify it, and a third to act as a monitor to the off-stage operator.

The simplicity of setting up a PA system that uses an FM microphone is another advantage that regular users would appreciate. For example, schools usually have a daily 'assembly', where teachers can impart instructions (or reprimand) the assembled classes, and the need to set up the PA is a procedure that often involves running out the microphone cable. An FM microphone makes all this much simpler, and would even free the teacher to be able to roam amongst the assembled masses. Great for on the spot discipline!

There are also many uses around the home for a wireless PA system. Amplifying speeches during the formal component of a party, or perhaps to give the kids a simple sound system are two fairly typical uses.

Or perhaps as a baby monitor. While the rest of the family enjoys a barbecue outside by the pool, the visitor's sleeping baby could be monitored by placing the microphone in the bedroom with a



The circuit diagram of the Radiomike. The audio signal, amplified by IC1, frequency modulates the oscillator section using Q2. After buffering with Q3, the output is fed to the helical antenna by Q4.

portable FM radio set up so Mum and Dad can hear it.

All the uses so far described assume the transmitter is acting as a microphone. However this project allows you to connect other inputs, instead of only a microphone element. You could use it to amplify a musical instrument, or any electrical signal in fact.

So, an FM microphone has the potential to be an extremely useful device. All it relies on is that you own an FM radio receiver, which seems a fairly likely possibility for *EA* readers.

The project

As already mentioned, cheap versions of FM microphones often suffer from several deficiencies. Typical is excessive change in operating frequency with antenna movement and battery voltage variation. Also, many of these units contain microphone inserts that are unsuitable for live entertainment situations, due to a poor signal to noise ratio. Often they will also sound dull, because they lack the pre-emphasis which is required in a standard FM system.

Pre-emphasis refers to tailoring the audio system to boost the higher audio frequencies according to a prescribed curve, prior to transmission. This is done to improve the signal to noise ratio, by allowing the incorporation of a de-emphasis network in the receiver's audio chain.

Such a network cuts the high frequencies along with any noise picked up on the way. To compensate, the audio signal needs to have had its high frequencies boosted at transmission. This scheme is normal practice, and forms part of the standards laid down for FM broadcasting, which means all FM receivers incorporate a de-emphasis network.

The FM transmitter described in this article not only overcomes all of these problems, but it also includes several extra features which are only found in professional microphones. For example the unit also includes a built-in helical antenna which is actually printed on the PCB.

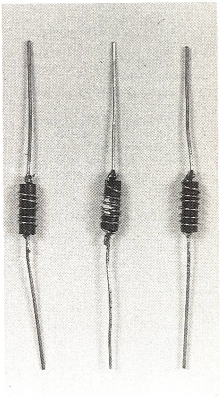
It has a low battery voltage indicator LED, and uses a good quality unidirectional electret microphone insert. The audio sensitivity is also adjustable, from a few millivolts up to hundreds of millivolts. This means that the transmitter could be driven by any microphone insert, or higher level audio signals such as line levels from electric guitars, keyboards, and so on.

The prototype was fitted with a good quality unidirectional electret microphone insert and there should be sufficient space available in the unit for most commercial microphone inserts. The whole thing draws approximately 12mA from its 9V battery, making it suitable for extended use.

How it works

The circuit shows the unit fitted with an electret microphone insert, with resistor R1 supplying the necessary DC voltage to the FET isolation stage which is fitted inside the microphone module. R1 should be deleted if a signal source other than an electret microphone insert is used.

The input signal is connected via C1, R2 and RV1 to IC1, which is connected as an inverting amplifier, biased to mid point operation by R3 and R4. The gain of this stage is adjustable by the setting of RV1. The series network of R5 and C3 included in the feedback path of IC1 provides a small amount of bass boost (6dB), to compensate for the lack of bass response inherent with an electret microphone. If this network is not required, it can be deleted without effecting the operation of the unit.



The three inductors are constructed as shown in this picture. Inductors L2 and L3 are wound on the formers identified with a white dot.

An improved FM microphone

PARTS LIST

1 PCB coded OE89FM
1 Unidirectional electret microphone insert
1 Windshield
1 DPST switch
1 9V battery connector
1 9V battery
2 Ferrite core formers (white dot)
1 Ferrite core former (no colour dot)
3 15uH inductors

250 x 32mm OD plastic tubing, two matching joiners, one matching end cap, screws, hook up wire, tinned copper wire, copper foil and self adhesive insulation material.

Resistors

All 1/4W, 5%:
1 x 100 ohms, 1 x 2.7k, 4 x 3.3k, 4 x 10k, 1 x 15k, 2 x 47k, 1 x 15Ok, 1 x 680k, 1 x 2.2M.
1 1M 5mm trimpot.

Capacitors

Disc ceramics: 1 x 2.2pF, 2 x 10pF, 5 x 20pF, 1 x 33pF, 1 x 180pF, 6 x 680pF
1 0.1uF monolithic
1 4.7nF polyester
3 10uF/16V low leakage electrolytics
1 2-10pF trimmer

Semiconductors

3 1 x 5.6V 400mW zener diode
1 5mm red LED
1 BC548 silicon NPN transistor
1 BF199 silicon NPN transistor
1 BF115 silicon NPN transistor
1 MFE131 dual gate MOSFET
1 TL071 operational amplifier

Kits of parts for this project are available from:

Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985
Postal Address (mail orders):
PO Box 89, Oatley West NSW 2223.

Complete Radiomike kit, including battery. ....$37.95 (P&P $2.50)
PCB only. .... $7.90 (P&P $1.50)

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The audio output from IC1 is applied via the parallel combination of C5 and R7 to the RF oscillator stage associated with Q2. Components C5, R7, R12 and C7 form the audio pre-emphasis network, which boosts the higher audio frequencies before the audio signal is applied to the oscillator stage.

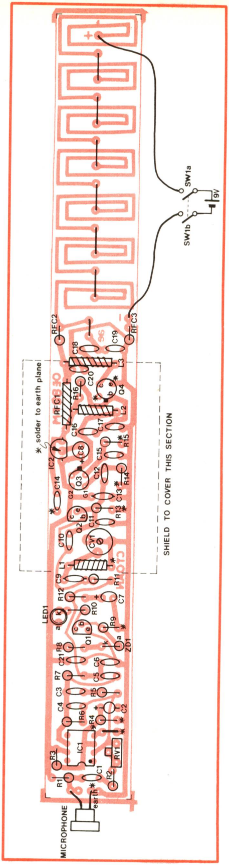
The oscillator uses a Colpitts configuration, and resistor R11 provides forward bias to the base of the Q2. Positive feedback is applied via C10 and the frequency of oscillation is mainly determined by the parallel tuned circuit L1 and CV1. The oscillator is frequency modulated by the audio signal, producing the required output signal at the emitter of Q2.

The output from the oscillator is applied via C12 to a wideband RF buffer amplifier stage, which uses a dual gate MOSFET (Q3). This stage provides a high degree of isolation for the oscillator stage. The output of this buffer amplifier is applied to the final output stage (Q4) by means of a parallel tuned circuit made up of L2 and the series combination of C16 and C17.

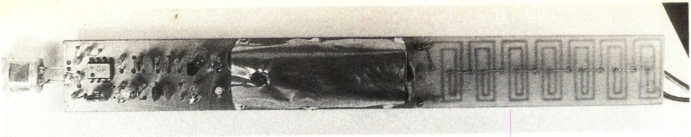
Inductor L3 and the effective series capacitance of C18 and C19 form a parallel tuned circuit, and C18 and C19 also provide a coupling network from Q4 to the helical antenna. Inductors RFC2 and RFC3 provide a path for the DC current from the battery to the transmitter circuitry but, due to their high impedance at the operating frequency, effectively AC isolate the battery from the rest of the circuit. This ensures that the printed helical antenna and the battery leads serve as the radiating element.

The battery voltage monitor circuit comprises transistor Q1 and its associated circuitry. When the battery voltage exceeds the sum of the base to emitter voltage of Q1 (0.6V) and the zener diode voltage (5.6V), Q5 is turned on and the LED lights via the current limiting resistor R10. This means the LED will light if the battery voltage exceeds 6.2V and extinguish for battery voltages which are below 6.2V, serving as a low battery voltage indicator.

The 5V regulator (IC2) is used to regulate the supply voltage which is applied to the audio amplifier/processing stage and the oscillator stage. Capacitors C14 and C20, together with RFC1 form a decoupling network to minimise any RF signal appearing on the power supply rail.



The PCB layout. All components mount vertically, and those marked with an asterisk should be soldered to the ground plane as well as the PCB pattern.



This photo shows how the RF shield was fitted to the prototype. Solder it to the ground plane on the component side of the PCB.

Construction

A complete kit of parts is available for this project from its designers, Oatley Electronics, who also provide the necessary technical support to constructors. For this reason, the PCB artwork is not included in this article. The kit includes a unidirectional electret microphone insert, the windshield and even the battery.

The construction of the 'Radiomike' can be divided into two parts: the mechanical (case) and the electrical (PCB and wiring). We begin by describing how to build the case, the dimensions of which are shown in Fig.1.

The case is constructed from a length of electrical plastic conduit, two joiners and an end cap. Begin construction by cutting the plastic conduit into two separate lengths of 230mm and 10mm. Next cut out a rectangular section (17 x 13mm) in the end cap to accommodate the on-off switch. Pre-wire the switch prior to fitting to the case. In the prototype the switch wires were passed through a hole drilled in the plastic spacer at the base of the switch, to provide strain relief and prevent the wires breaking during battery replacement.

Beside gluing the parts as shown in Fig.1 with a suitable type of plastic cement, (electrical conduit glue is fine), two small holes need to be drilled for the screws that attach the end section to the main body of the case. This section needs to be removable to allow access to the battery.

A hole should also be drilled in the correct position in the case to enable the battery voltage monitor LED to be viewed. Also, drill a grid pattern of 5mm holes around the perimeter of the top joiner, as shown in Fig.1. After completing the case, you can now turn your attention to the electronics.

The first task is to wind the three inductors L1, L2 and L3, by winding the correct number of turns on the supplied ferrite cores. The kit includes the necessary wire and ferrite cores, which are identified by a white spot in the case of

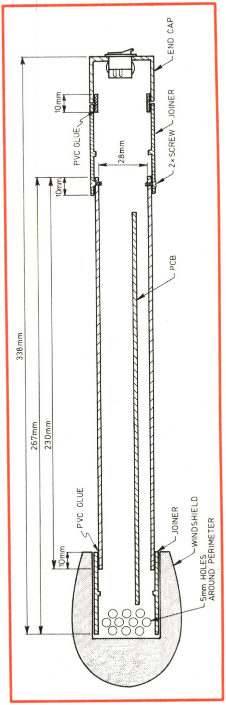
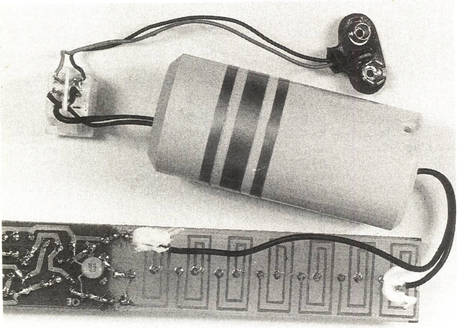
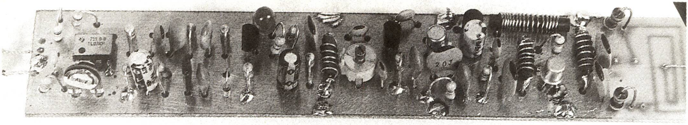


Fig.1: The case dimensions. Use PVC glue to glue the various sections together as shown and two screws to attach the bottom section.



A shot showing how the battery and switch are connected to the PCB. Note how the wiring is anchored at the switch and glued at the PCB.

An improved FM microphone



The prototype showing the component side of the PCB, with the shield removed. Capacitor C20 was mounted on the underside in this unit, but will mount next to L3 on the supplied PCB.

those to be used for inductors L2 and L3. The core for L1 has no marking, and this inductor is made by winding 5 turns of tinned copper wire around the core, terminated to the pigtails attached to the core.

Inductors L2 and L3 require 6 turns each, using the cores marked with the white spot. The start and finish of the windings for all the inductors should be located within the notches in the ferrite, prior to being soldered to the pigtails.

Having wound the inductors you can now assemble and solder all the required components on the PCB. The PCB has a ground plane on the component side, and some of the component leads that connect to the common track of the PCB are also soldered to the ground plane. This ensures that the ground plane is connected to the common rail of the PCB pattern.

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The common lead (centre terminal) of IC2 and the earth side of C14 both derive their earth connection from the ground plane. The connections to the ground plane are shown with an asterisk on the layout diagram.

All components are mounted vertically to minimise the space requirements, and should be installed as shown on the layout diagram. In the prototype, IC1 was soldered directly to the PCB, rather than being mounted in a socket. There are several wire links required, particularly between each section of the helical antenna.

One important point to watch is that the inductors need to be mounted sufficiently clear of the PCB so that their windings do not touch the ground plane. Check carefully for correct orientation of all the polarised components, particularly the three electrolytic capacitors. The electret microphone insert is also polarised, and the case should be connected to the common rail.

Finally, connect the battery leads to the PCB. The positive lead connects to the centre of the end-most helical section of the antenna, and the negative end connects as shown on the layout diagram. A spot of glue at these connection points is recommended to help prevent the wires breaking, due to stress during a change of battery. The switch should be wired so that it switches both battery leads, as shown on the circuit.

After double checking all the wiring and component locations, connect a 9V battery to the unit, and switch on. The LED indicator should light, indicating power to the circuit. If all is well so far, it remains to tune the transmitter to a suitable frequency.

Tuning it up

Although the Radiomike produces useful power output across the whole FM band, it actually produces most power at the lower frequency part of this band. The tuning of the buffer stage and the final amplifier stage operates most efficiently at frequencies from approximately 88MHz to 98MHz. For initial testing you should find an unoccupied frequency within this range on an FM radio and tune the transmitter to this frequency by carefully adjusting CV1. No other tuning is necessary.

For best frequency stability the RF section of the PCB should be shielded, although this may not always be necessary, depending on the surroundings. The shield on the prototype was made from a piece of copper foil, which was soldered directly to the ground plane of the PCB. This section is shown with dotted outlines on the layout diagram.

The setting of RV1 will depend on the sensitivity of the microphone element and the receiver. Adjust it to give the best results by experimenting with various settings. Once the unit has been tuned, it can now be assembled into the case.

Final assembly

The complete PCB should slide inside the plastic case and be self supporting. It may be necessary to form the LED and the RF shield, to allow the assembly to fit. The 9V battery is a tight fit, but sits inside the main body of the case, between the PCB and the switch.

Once everything is fitted the switch should be inserted into the cutout in the bottom section of the case, and this section attached to the rest of the case by the two screws.

The windshield is a push fit over the top section and need not be glued. You may perhaps like to dress the case up by applying a few bands or other decoration to complete the job. Then you are 'on the air'.

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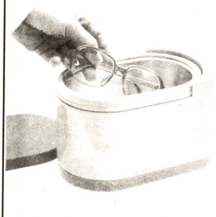

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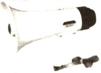

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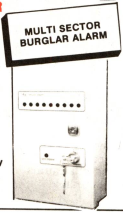

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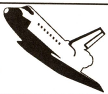

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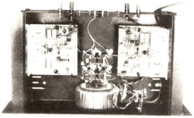

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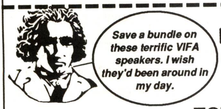
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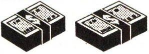

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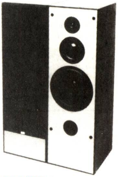

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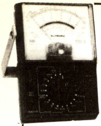

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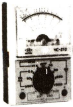

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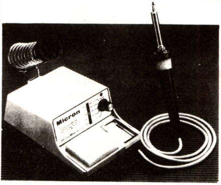

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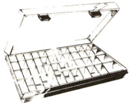

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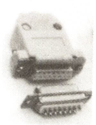

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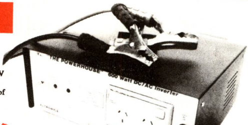

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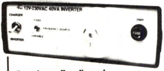

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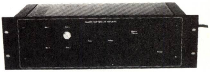

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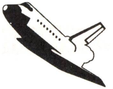

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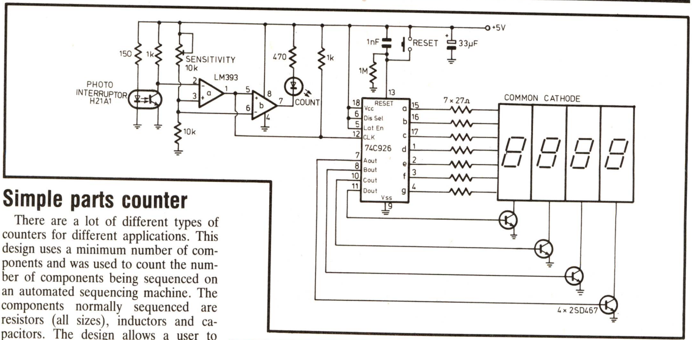
Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.



Simple parts counter

There are a lot of different types of counters for different applications. This design uses a minimum number of components and was used to count the number of components being sequenced on an automated sequencing machine. The components normally sequenced are resistors (all sizes), inductors and capacitors. The design allows a user to calculate the loss of components during the sequencing process. That is the amount put on the rack – the reading on the 4 digit LED display. The sensor is a photo interruptor and has a sensitivity adjuster.

The H21A1 photo interruptor senses when a component is passing. When this happens pin 2 of the LM393 goes high, pin 1 goes low thus causing the counter to advance 1. When no component is passing through the photo interruptor, pin 6 goes low, thus causing pin 1 to go high again.

The sensitivity of the counter can be adjusted through the 10k trimpot. The LM393 is an open collector comparator that compares pin 2 and 3 and produces an output. The collector must be connected with an external resistor in order to have an output.

The counter/driver/display section uses a single chip (74C926). The counter must be reset during power on. This happens only when pin 13 is high. PBI is used in order to reset the counter manually. Pin 6 is held high so that the ouput counter is displayed. To prevent overheating of this chip, it is advised that resistors are added at the outputs as shown, in order to limit the current flowing into the anode of the displays.

Ranjit Singh,
Pahang Darul Makmur,
Maylaysia

$30

Self-arming ignition killer

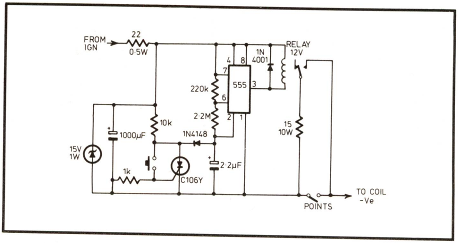
I have built several of the 'ignition killer' projects which first appeared in EA some time ago. The only drawback with the design is the necessity to remember to arm the device by activating a hidden toggle switch. If this is not done then the vehicle is as vulnerable to theft as any other.

I have modified the circuit to be self arming whenever the ignition is first turned on, with the operation of a hidden, momentary action push button being necessary to disable the device and allow the engine to run.

As can be seen by the schematic attached, this is easily achieved by wiring the ignition supply directly to the 555 timer (without the toggle switch) so that the killer will begin it's cycling as soon as the ignition key is turned to ON. To stop this cyclic action a momentary contact triggers the gate of a C106Y1 scr, which pulls pin 2 of the 555 to ground. A 1k resistor effectively de-sensitises the scr to prevent false triggering and a 1N4148 diode blocks pin 2 of the 555 from seeing the holding voltage for the scr (supplied by the 10k resistor).

W.J. Sherwood
Alinjarra, WA

$25



Low-cost substitute for multi-turn pot

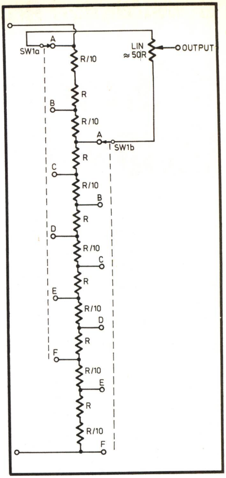
From time to time, circuit designers call for a multi-turn linear potentiometer – usually to provide smoother adjustment and greater resolution than is available using a standard pot. Unfortunately multi-turn pots tend to be relatively hard to obtain, and in any case they're quite expensive. Quite often they must also be fitted with a counting dial assembly, adding even more to the cost.

The circuit shown here can provide a low-cost alternative to a multi-turn pot, using a 2-pole rotary switch and a regular single-turn pot. The fixed resistor divider chain and switch poles effectively 'step' the pot along, in increments roughly equivalent to a single turn of a multi-turn pot.

Why the small additional resistors R/10, as well as those marked with value R? Without these, there would be small gaps in between the end of one adjustment segment and the beginning of the next. The R/10 resistors and staggered tapping points for SW1a and SW1b ensure that the segment ranges overlap slightly, to give contiguous adjustment over the full range.

I developed this arrangement for an application where it was used to adjust the tuning voltage applied to varicaps. Here the divider values were 180 and 18 ohms, and the pot value was 10k. Although a six-stage divider is shown, to suit a readily available 2 pole x 6 position switch, further stages may be added if desired – providing a suitable switch is available.

Jim Rowe,
Electronics Australia.



Keyboard sound improver

Do you own one of those Casio or Yamaha keyboards with the tiny two inch speakers ...? Tired of that very tinny sound ...?

This circuit will allow you to add more or less treble and bass to your keyboard output. It also connects to your stereo amplifier, and allows you to take the lead with your favourite piece of music.

The circuit revolves around two IC's, the 741 and the LM324. The 741 acts as a Baxandall treble/bass control unit, with Pots VR3 and VR4. The signal is then passed to two isolated amplifiers IC1a and b. The volume of the keyboard sound can be set via VR1.

The stereo music (from a tape deck, etc) is connected to the inputs indicated. What occurs here is the summing of a stereo signal with a mono one. The result will be that the stereo signal remains as normal and the mono signal sounds as if it is in the middle of the two. IC1c and d are the two overall amplifiers allowing you to adjust the total output volume via VR2.

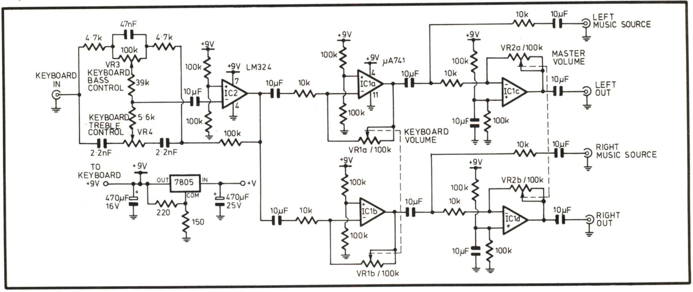
The voltage regulator can also provide your keyboard with its own power supply, one that avoids the hum produced by cheap power supplies.

Since there are four controls that are meant to be within easy reach, a reasonably large box with a sizeable front panel will be needed.

If your keyboard requires a different working voltage than 9V, then the regulator resistors or the regulator itself can be changed. The current consumption without the keyboard should be around 10mA and no heatsink is needed, except maybe for the 7805 – depending on the current consumption of your keyboard.

Darren Yates
Frenchs Forest, NSW

$30



Construction Project:

Interior light delay for your car

Here's a useful little unit that will delay the switch-off of a car's interior light after you enter the vehicle. It will also dim the interior light, for such things as map reading while driving at night. The design won the authors a 'runner-up' prize in our recent Dick Smith Electronics/EA Grand Aussie Hobby Electronics Contest.

by JOHN THOMPSON & ROSS DANNECKER

In the January 1980 issue, *Electronics Australia* published the design for a car interior light delay unit using discrete transistors. It suffered from the problem that if the door pin-switch became wet and therefore slightly conductive, the interior light would glow dimly even with the doors closed – and smoke would issue from a very hot power transistor in the circuit!

This new design overcomes that problem and also provides a facility to dim the interior light.

When a car door is opened, the interior dome light comes on and stays on for around 20 seconds after closing the door. This provides ample time for fastening seat belts etc., at night. When the car headlights are switched on, the interior light immediately goes out, but will come on and operate without a delay if the door is opened with the headlights on.

A variable control is also provided to dim the interior light to a desired level. The interior light can also be switched on while driving, and dimmed to a level suitable for map reading etc.

Circuit description

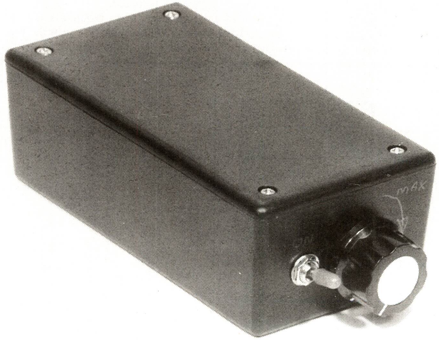
IC1 is a hex CMOS Schmitt-trigger inverter type 74C14. It differs in operation from a standard CMOS inverter in that the input voltage must exceed about 2/3 of the supply voltage before the output voltage will switch to zero. Likewise, the input voltage must be taken to below 1/3 of the supply voltage before the output will change from zero to supply voltage. This effect is known as hysteresis, and gives the 74C14 very useful properties for level detection and timing circuits – as does the high input impedance of CMOS devices.

With the car's pin door switches all open circuit (doors closed), the input voltage to IC1a is greater than 2/3 of the supply volts (the 'high' or logic 1 state), so its output is at zero volts (the 'low' or logic 0 state). When a door is opened, the input to IC1a changes to 'low' as the pin switch provides a short circuit to ground. The output of IC1a then goes 'high'.

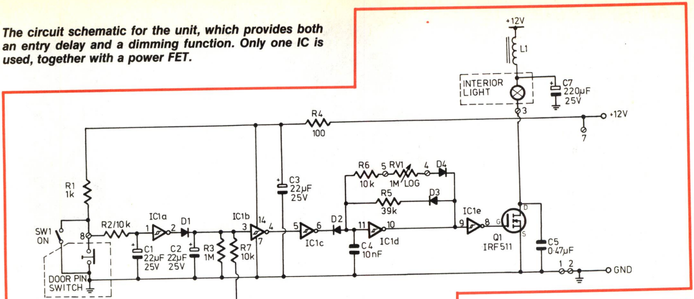
Resistor R1 limits the current through the pin switches to around 12mA. Mechanical contact switches in a potentially dirty and corrosive situation like a car require a modest 'wetting' current to punch through oxidisation, etc. Also if a switch should become wet and therefore slightly conductive, the circuit should not switch on the interior light. In this case if the leakage resistance of the switches is greater than 2k ohms, the circuit will function normally).

R2 and C1 limit any currents from outside sources – for example static voltages, which might damage the IC. They also help to keep unwanted radio frequency (RF) signals from causing any malfunction in the operation of the circuit. The short (0.2 second) time constant they produce does not affect circuit operation.

Neglecting for the moment the components around them, inverters IC1a, b, c, d and e are simply connected in



The circuit schematic for the unit, which provides both an entry delay and a dimming function. Only one IC is used, together with a power FET.



series. A 'high' on the input of IC1a (doors closed) will therefore produce a 'low' on the output of IC1e.

Q1 is an enhancement mode power MOS field effect transistor (FET). When the voltage between gate and source is 0, the resistance from drain to source is close to infinite (open circuit). When the circuit changes the gate voltage from 0 to around +12V, the resistance from drain to source drops to less than 1/2 of an ohm and the light is switched on. Thus when a door is opened, the light is switched on in the normal way.

When a door opens and the output of IC1a goes 'high', this rapidly charges up capacitor C2 via diode D1, which is forward biased. The input to IC1b goes 'high' and the light is switched on. When all doors are then closed and the output of IC1a goes 'low', C2 slowly discharges through R3 and the light will stay on for around 20 seconds – until the voltage across C2 drops to less than 1/3 of the supply voltage ('low'). The output of IC1b now snaps from 'low' to 'high' and the light goes out.

IC1f and its associated components provide the useful feature of switching off the interior light when the headlights are switched on, after all doors are closed.

When the headlights are off, the input to IC1f is 'low' so its output is 'high' and diode D5 is reversed biased – so the timing circuit C2/R3 is not affected. But when the headlights are switched on, the output of IC1f goes 'low', D5 is forward biased and C2 is rapidly discharged through R7. This switches off the interior light.

However if a door is still open, the output of IC1a will still be 'high' and it supplies enough current (which flows through D1, R7, D5 and IC1f) to keep the input of IC1b 'high' – and hence the interior light stays on. When the final door is closed with the headlights on, the interior light goes out almost immediately.

Resistor R8 is included to hold the input to IC1f 'low' in case the headlight control option is not wired up. R9 and C6 provide protection and filtering in the same way as R2 and C1.

Consider now IC1d and its associated components. This is in fact an astable oscillator, of variable duty-cycle or 'mark-space' ratio.

The basic astable oscillator using a Schmitt-trigger CMOS inverter is shown in Fig.1. At switch-on the capacitor is discharged, so the input to the inverter is 'low' and its output is therefore 'high'. The capacitor now charges up through the resistor until the input voltage to the inverter reaches 2/3 of the supply voltage. The output of the inverter now switches to the 'low' state and the capacitor begins to discharge through the resistor, until the voltage at the input to the inverter reaches 1/3 of the supply voltage. The output of the inverter now switches to the high state and the whole cycle repeats itself.

The output voltage of the inverter will therefore be a square wave, with frequency depending on the values of the resistor and capacitor.

The circuitry around IC1d in the final

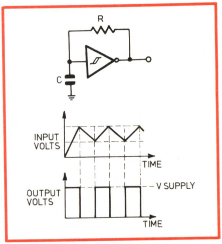


Fig.1: The basic CMOS inverter oscillator.

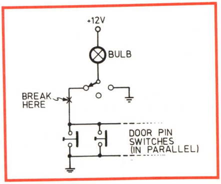
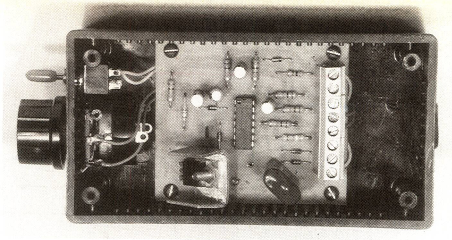


Fig.2: Where the lamp wiring is broken.



Inside the case, showing the way the PCB and other parts are mounted – plus the components on the PCB itself.

design is similar, but diodes D3 and D4 cause capacitor C4 to charge up through R5 and to discharge through R6, in series with RV1. When RV1 is set for 29k resistance, R6+RV1=39k so the output of IC1d is a square wave (equal charge and discharge times, or a 50% duty cycle). When RV1=0, the duty cycle becomes 80% high and 20% low. When RV1=1M, the duty cycle is 3% high and 97% low.

The output of IC1d is of course inverted by IC1e, so the output of IC1e will be high for between 20% and 97% of the time when IC1d is oscillating – i.e., the FET will be conducting and current pulses will flow through the bulb for between 20% and 97% of the time.

Because of the thermal inertia of the bulb and the relatively high frequency of oscillation of IC1d (100-5000Hz), the light output of the bulb will be varied as though there were simply a high wattage variable resistor in the series with the bulb. However, since the FET's resistance is in fact either infinite ('off') or around half of an ohm ('on'), the power dissipated by it will be small. With the light bulb at maximum brightness and a current of say 2 amps through the bulb, the power dissipated by the FET is less than one watt.

So the average current through the interior light bulb can be varied by RV1, to dim the light as required. C5 slows down the edges of the current pulses through Q1, preventing harmonics of the switching frequency from interfering with radio reception.

When the doors are closed and C2 has discharged to below 1/3 of the supply voltage, the input to IC1b is low, so the output of IC1c is low and the input to the oscillator IC1d is held 'low' through forward-biased diode D2. The output of IC1d therefore stays 'high' (no oscillation), the output of IC1e is 'low', the FET is not conducting and the interior light is off.

But when a door is opened, the output of IC1c goes 'high', D2 is reversed biased, oscillation begins and the light is switched on.

The current drain of the circuit when the light is off is less than half of a milliamp, so it will have a negligible effect on battery discharge.

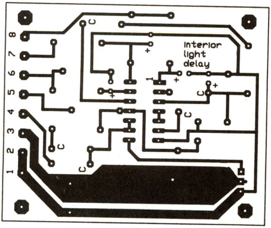
Construction

The complete circuit, apart from the variable resistor and switch, mounts on a printed circuit board measuring 70 x 58mm and coded 89ld05. An 8-way screw terminal connector on the board provides all exterior connections. All components are commonly available. (The power FET is available from Tandy.)

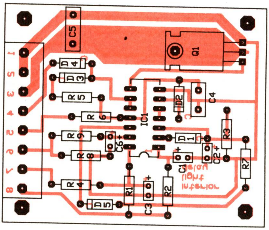
The resistors, diodes and capacitors can be mounted on the board first, noting the orientation of the diodes and electrolytic capacitors, and soldered. The screw connector should next be mounted and soldered. Observing static precautions, the CMOS IC should now be soldered in, noting the orientation. Use of a socket is not recommended, because of vibration in the automotive environment.

Finally the power FET can be mounted, again noting the orientation. These devices are particularly static sensitive, so leave the conductive foam on the leads close to the body while soldering in. Then carefully remove all of the foam. Bolt the FET to the copper section of heatsink on the board.

Like most electronics in a vehicle, the circuit board should be mounted in a metal rather than a plastic box for RF shielding. Holes should be drilled in the box to mount the circuit board and for mounting the box in the vehicle. A hole should also be drilled for the rubber grommet, through which the leads from the screw terminal connector will pass. If the box can be mounted in a position which is accessible during driving, the



Left: the PCB etching pattern, reproduced actual size. Right: the overlay wiring diagram, showing the location and orientation of all components.



PARTS LIST

Miscellaneous

- 1 PCB, 70 x 58mm, coded 89ld05
- 1 8 way PCB terminal block
- 4 PCB standoffs
- 5 Nuts and bolts
- 1 Jiffy box, 131 x 68 x 45mm
- 1 DC smoothing choke (DSE L-1900)

Grommet, wire, solder, knob etc.

Resistors

All 1/4W 5%: 1 x 100 ohms, 1 x 1k, 5 x 10k, 1 x 39k, 1 x 1M, 1 x 1M log pot

Capacitors

- 1 10nF 50V metallised polyester
- 1 0.47uF 50V metallised polyester
- 4 22uF 25V PC mount electrolytics
- 1 220uF 25V PC mount electrolytic

Semiconductors

- 5 1N914 diode
- 1 74C14 IC
- 1 IRF511 power MOSFET

variable resistor and switch can be mounted in the box. If not, then they can be mounted external to the box – e.g., somewhere in the dash and suitably labelled.

The existing wire from the car's door pin switches to the interior light should be cut, as in Fig.2, and wires run to the screw terminals. A suitable earth and battery positive from the fuse that supplies the interior light should also be connected. Finally a wire should be run from the +12V side of the headlight wiring (common to both high and low beam).

A copy of the vehicle's wiring diagram showing the colour codes of the wires is most useful. Remember that the wires from the interior light bulb and the earth must carry up to 2 amps.

No adjustments are required and circuit troubleshooting should require only a DC multimeter. It is recommended that the +12V supply to the top of the light bulb be decoupled with a DC smoothing choke and a 220uF/25V capacitor, as shown in the main circuit, to prevent the current pulses from causing any interference to other car electrics.

If the dimming facility is not required, omit the components around IC1d and replace D2 with a wire link. The decoupling components can also be omitted.

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Legislation is being introduced to limit CFC products in all states during 1989

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MADE IN AUSTRALIA FOR AUSTRALIAN CONDITIONS

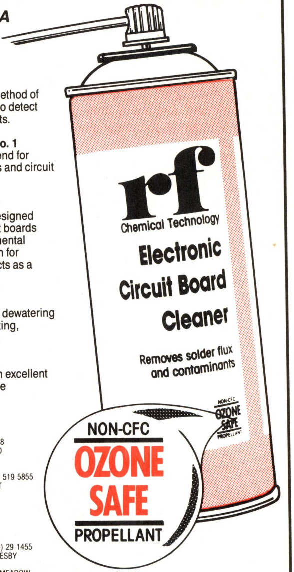
Electronic Freezing Spray
Non-CFC, non-corrosive, safe method of cooling electronic components to detect dry joints and other thermal faults.

Electronic Cleaning Solvent No. 1
Fast drying non-CFC solvent blend for cleaning electronic components and circuit boards.

Printed Circuit Board Lacquer
Specially formulated lacquer designed specifically for protecting circuit boards and components from environmental attack. Can be soldered through for component replacement and acts as a solder flux.

Proteck
General purpose maintenance, dewatering and penetrating fluid for protecting, lubricating and rust prevention.

Heat Sink Compound
An efficient, not-toxic paste with excellent thermal conductivity over a wide temperature range.



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Construction project:

New, improved Teletext decoder – 1

Here's a new design for a Teletext decoder, intended to replace the popular design published in our August-September 1984 issues. It uses a new decoder chip set, resulting in a somewhat smaller PCB and significantly simpler construction – along with lower cost.

The new Teletext decoder design presented here uses only three chips to replace the four dedicated chips used for decoding in the earlier design. Two are used for the actual Teletext decoding, and one for a controller. As a result, PCB size and complexity of construction have both been greatly reduced.

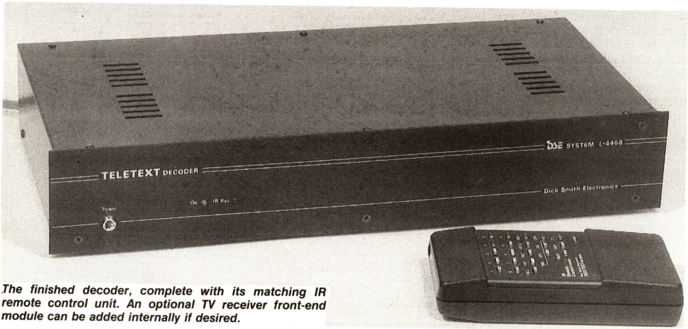
The design is presented here in its basic form, for use with video and audio signals from a video cassette recorder (VCR). In a later article, an independant TV-tuner PCB module will be described, which can be included in the same case, allowing up to 6 preset stations to be remotely selected from the Teletext decoder's IR remote controller.

The design work for this project has been carried out by the R&D department of Dick Smith Electronics, by the way. The design is well proven, having been already used in complete wired-and-tested Teletext decoders sold by DSE. The company has now decided to release the design for home constructors, and is also marketing a complete kit. The kit is known as the K-6360, and includes both the basic decoder and the matching IR remote control unit. It will be available through DSE stores and dealers by the time you read this article.

The two latest-generation Teletext chips used in the decoder are the SAA5230 'VIP' video input processing circuit and the SAA5240 'EURO CCT'. The VIP separates the Teletext information from the TV signal and also regenerates clock and sync signals for the Teletext display.

EURO CCT is an acronym for EUROpean (language set and 625-line) Computer Controlled Teletext. The EURO CCT acquires the Teletext data, stores it in memory after error checking, synchs its display output with the TV synch, has its own character generator, provides READ access to the stored Teletext page information, and communicates with the controlling computer IC (IC8) by means of a two-wire serial bus – the I^2C (Inter-IC) bus.

To control the EURO CCT chip via the I^2C bus, a single chip computer, the Motorola 68705, has been chosen. This versatile chip has the advantage of requiring almost no support devices around it. It contains 1.8K bytes of ROM, storing the control program, 100 bytes of RAM, a timer and I/O interface circuitry.



The finished decoder, complete with its matching IR remote control unit. An optional TV receiver front-end module can be added internally if desired.

The new Teletext decoder has no inbuilt control panel. Instead all commands are given to it from an IR (infra-red) hand-held remote control unit – much more convenient, and nowadays the preferred approach.

The commands from the IR hand controller are decoded and processed by the 68705 CPU and then sent to the EURO CCT via the I^2C bus.

How it hooks up

In its basic state (with the TV-tuner module not present), the video input of the decoder must be connected to the video output of a video cassette recorder (VCR), to derive off-air video signals. Similarly the audio input of the decoder is connected to the audio output of the VCR, to allow muting via the remote control and also transfer to the TV receiver.

The decoder includes an RF modulator for convenient coupling of both picture/Teletext video and audio to the TV receiver. The RF input (aerial connection) of the receiver, which may have previously come from the RF output of the VCR, is now connected to the RF output of the Teletext unit. The RF modulator in the decoder is set for VHF channel 1, so the receiver should be set for this channel.

The decoder also provides direct video and audio outputs, which may be connected to composite video monitors (or other VCRs), or audio amplifiers respectively, should this be required.

Functions & features

Upon initial power-up, the decoder will default to TV-Mode with the sound on. In this mode the active controls available on the IR handset are as follows:

1 – 6: These will select any of the 6 preset stations setup on the internal TV tuner module, when this is added to the project. They are not operational otherwise.

MUTE: This will cut the sound off until MUTE is pushed again, when the sound will be restored.

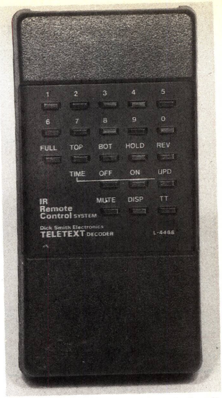
TT (Teletext/TV toggle): This key changes the display from the normal TV mode into Teletext mode, in which all of the other keys on the IR controller become functional for normal Teletext control. The screen will be blanked, and initially an 'A' will appear in the top left corner of the screen. More on this later, but pushing TT button again will toggle the system back into the TV mode.

Teletext mode

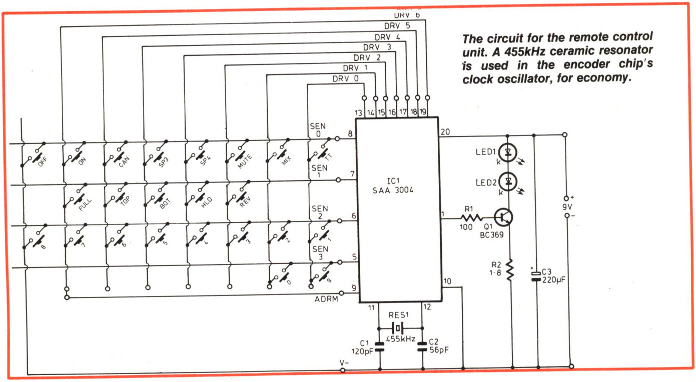
In this mode, which is entered by pressing the TT button, the 'A' will appear. This means we are in Display A of the two displays – see the DISP command for further details of this. Selection of a desired Teletext page is done as follows.

First ensure that you are tuned into a TV station that is actually transmitting Teletext (i.e., in Sydney channel ATN-7). Next, using the numeric keys, type in a page number – for example 100. You should be able to observe these numbers being echoed onto the screen beside the A.

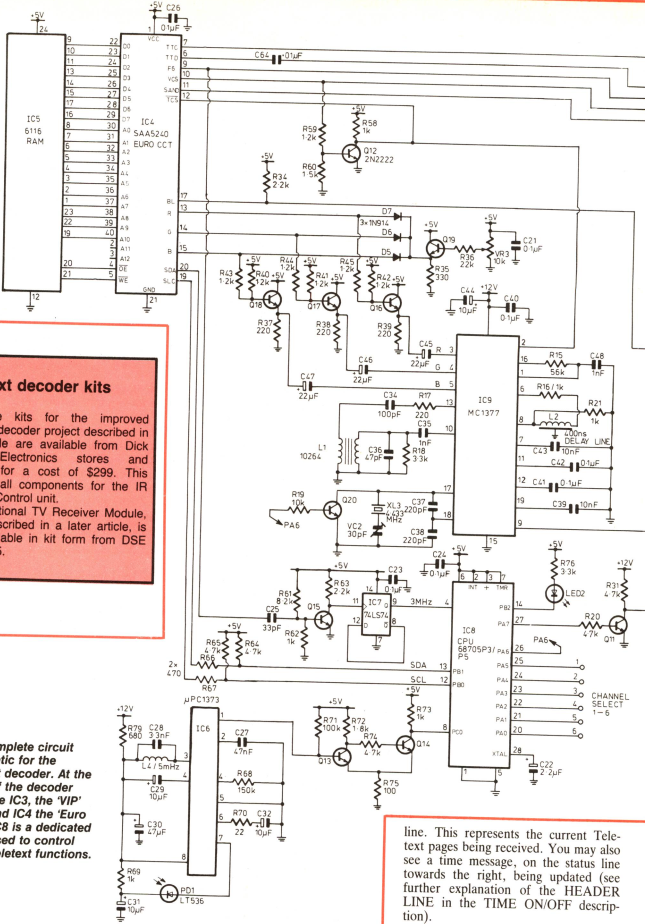
Once all three digits have been entered, a green 'rolling page number' will appear in the middle of the top status



A close-up of the remote control unit, showing the control keys.



The circuit for the remote control unit. A 455kHz ceramic resonator is used in the encoder chip's clock oscillator, for economy.



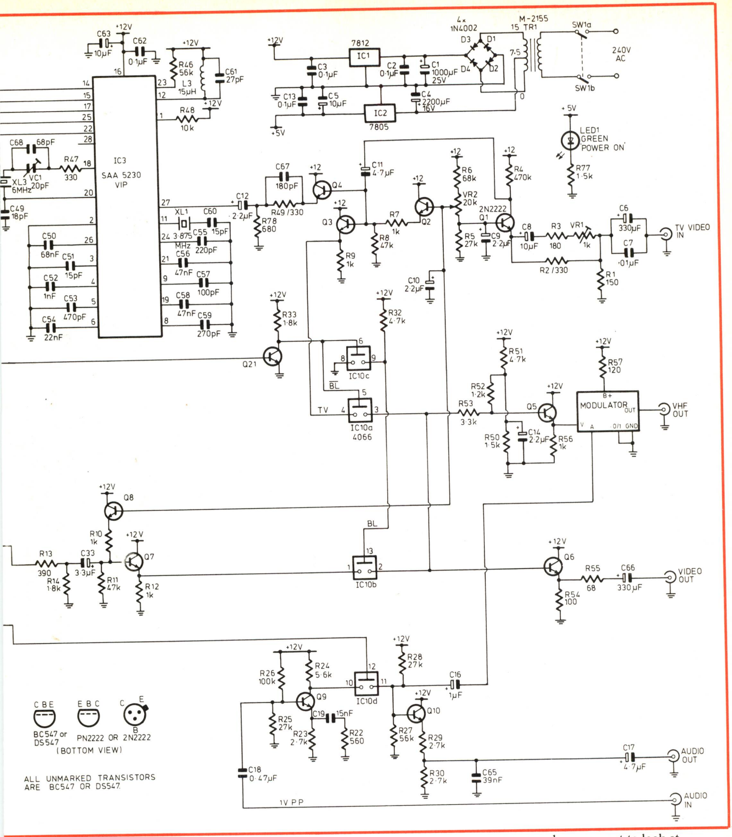
Teletext decoder kits

Complete kits for the improved Teletext decoder project described in this article are available from Dick Smith Electronics stores and dealers, for a cost of $299. This includes all components for the IR Remote Control unit.

The optional TV Receiver Module, to be described in a later article, is also available in kit form from DSE for $69.95.

The complete circuit schematic for the Teletext decoder. At the heart of the decoder itself are IC3, the 'VIP' chip, and IC4 the 'Euro CCT'. IC8 is a dedicated CPU, used to control IC4's Teletext functions.

line. This represents the current Teletext pages being received. You may also see a time message, on the status line towards the right, being updated (see further explanation of the HEADER LINE in the TIME ON/OFF description).



Once the desired page has been received, the green 'rolling page number' will revert to white, meaning that the page has been found, and the contents of that page will be displayed. This is because the signal to the decoder chip to search for a page is made when the last of the three page numbers has been entered. If a page number has been entered that doesn't exist, then the green 'rolling page number' will remain green, and rolling, rather than revert to white. If this is the case, enter another page or go back to the index and check what page number you want to look at.

Here are the functions of the additional keys on the remote control, which become operational in Teletext mode:

DISP: This key toggles the display you are looking at. There are two page display memories, 'A' and 'B'. Different Teletext pages can be acquired and stored in A and B simultaneously (but not the same page). It is quite useful to have an index page held (see HOLD) in display A, then go to display B to look at specific pages. The selected page will be acquired, even if it is not currently being displayed.

REV: This key enables the *Reveal* function. Some pages have display information concealed, until this button is pushed; for example a quiz page may have the answers concealed. The REV button toggles between reveal-on and reveal-off. Its default setting upon power-up is reveal-off.

FULL/TOP/BOT: These keys control the character height of the Teletext being displayed. They are useful for discerning text if the viewer is at some distance to the TV screen. As a result of doubling the height of the characters, only half the display can be seen at once. Hence the Top can be viewed, or the Bottom. To revert back to normal height or full size, use the FULL key.

HOLD: This key/feature stops any further acquisition and holds the current Teletext display. When HOLD is pressed, an 'H' will appear after the white page number entered at the top left of the screen (e.g., 'A 100 H').

This feature toggles, and pushing HOLD again will remove the 'H' from the display, and re-enable acquisition. This is a handy feature, because unless a page is 'held', it will be reverted back to page 100 whenever TT is used to return to TV mode. For example if index page 200 is useful to have available for quick access, acquire this page and 'hold' it. Then after going to TV mode and back to Teletext mode (via the TT key) page 200 will still be present, whereas the other display will have reverted to, and reacquired page 100.

TIME OFF/ON: The Time On key will enable a four-digit time to be entered with the numeric keys (in 24-hour format, e.g. 6pm = 18:00), and used for an 'alarm-clock' feature. After the 4-digit time has been entered, the UPD button is used to revert the display to a normal TV display. It will remain in TV mode until the time entered is encountered, and will then revert back to the Teletext page previously being displayed.

To get out of this mode, push TT and the display will revert back to the previous Teletext page. The Time Off key is used to exit from the time entry mode.

There are several things to note with regard to this function. A valid Teletext page must be used (there are even specific 'alarm-clock pages'); this is because the time digits are now included in the page comparisons. Therefore if a non-transmitted page number has Time-on digits included, although the time will register, the display will not alter because the requested page numbers will never be found.

Similarly, when Time-on is requested whilst in a valid transmitted page, the display will only be updated (revert back to Teletext display) when the page number is re-acquired, which means not necessarily exactly on the second of the specified time. This is a function of how often the Teletext page is transmitted by the TV station; sometimes this is up to 25 seconds apart, but for index pages and subtitle pages it is considerably more frequent.

The current TIME information is included in the transmission of the Teletext page HEADER, which is the first line of each page transmitted – and seen as the very top line of the Teletext display. The first 8 characters from the left of this line are not displayed, but they contain the PAGE NUMBER and TIME DATA. It is this invisible data that is used for comparison during search and acquisition.

The other 32 characters of this line are standard display information, but are normally consistent in that they contain the PAGE number of the display, towards the center, and the TIME, if available, towards the right. Therefore in some cases, correct time may be seen on the right (as part of the visible header display), while having the TIME data in the invisible first 8 characters, unused and zeroed (as mentioned later).

As the first 8 characters of the received page are not displayed, these character positions are used by the control program in the Teletext decoder for status information – e.g., echoing of the PAGE number requested or TIME setup.

It is this last 32 characters of the HEADER line that are seen when the page numbers are 'rolling' when searching for a new page.

Also you should be aware that some Teletext transmissions do not send current time data in the first 8 characters of the header, but time data that is zeroed to 00:00. This is the case with ABC-TV teletext at present, and also the case with the '300s' magazine of ATN-7 – although other magazines of ATN-7 contain normal standard time.

UPD: This is the Update key, which has two functions. First, it is used to revert to a TV display after entering Time details for a timed page, as mentioned. Second, it is used on the 'newsflash' page.

The newsflash page is keyed in normally and should be able to be seen as a subtitle block, with the newsflash in it, on top of the normal TV picture. Now, if UPD is entered, the subtitled newsflash will disappear, leaving a normal TV picture – until a different newsflash is transmitted.

When a new newsflash arrives, the TV picture will then display the newsflash, in the subtitled format, and remain in this display mode until the UPD button is pushed again. As before, pushing the UPD key will remove the newflash from the TV display and thereafter wait for another newsflash. Pushing the TT key will get out of this mode, and display the subtitle message again.

How it works

Referring to the circuit diagram, the incoming video input signal is terminated via R1 and applied to Q1, which is connected in a common base configuration.

The video signal is further buffered and clamped by Q3 and then presented to one section of video switch IC10a, at pin 4. The output of this switch at pin 3, and another IC10b at pin 2, is determined by the EURO CCT blanking signal (pin 17, IC4), via buffer transistor Q21 and IC10c, connected as an inverter to drive IC10b in opposite sense to IC10a.

The EURO CCT is therefore able to switch between Teletext output only (via colour encoder IC9, Q7 and IC10c), in the full Teletext mode, to TV only in the TV mode (via Q3 and IC10a). In the subtitle or newsflash modes this switching of video signals happens at the line scan rate.

The output of the video switches is buffered by Q6 to provide the decoder's direct video output, and DC level shifted by Q5 to provide a suitable signal input for the RF modulator.

VR2 effectively alters the DC bias to the inputs of both CMOS video switches IC10a and IC10b.

In a similar way to the video, the audio input signal is buffered by Q9 and switched by CMOS switch IC10d, under control of the 68705 CPU chip (IC8),

PARTS LIST – TELETEXT DECODER

1	Main PCB
1	Front panel
1	Chassis assembly
1	Crystal 4.43361MHz
1	Crystal 6MHz
1	Crystal 13.875MHz
1	Transformer, Toko 166NNF 10264AG
1	Transformer, M-2155
1	400ns delay line
1	15uH choke
1	5mH choke
1	LT 536 photo diode
1	Red LED
1	Green LED
1	Modulator LVM2AU01
1	4 way RCA connector block

Semiconductors

4	IN4002 diodes
3	IN914 diodes
2	2N2222 or PN2222 transistors
19	DS547 transistors
1	7812 voltage regualtor
1	7805 voltage regulator
1	SAA 5230 VIP chip
1	SAA 5240 Euro CCT chip
1	6116 static ram
1	uPC 1373 IR preamp chip
1	74HC74
1	68705 P3/P5 CPU
1	MC1377 colour encoder
1	4066 CMOS switch

Capacitors

2	15pF ceramic
1	18pF ceramic
1	27pF ceramic
1	33pF ceramic
1	47pF ceramic
1	68pF ceramic
2	100pF ceramic
1	180pF ceramic
3	220pF ceramic
1	270pF ceramic
1	470pF ceramic
1	1000pF ceramic
1	1nF metallised polyester
1	3.3nF metallised polyester
5	10nF ceramic
1	15nF metallised polyester
1	22nF ceramic
1	39nF metallised polyester
3	47nF metallised polyester
1	68nF ceramic
12	0.1uF ceramic
1	0.47uF 16V RB electro
1	1uF 16V RB electro
1	2.2uF 16V axial electro (pref 12.5mm body)
4	2.2uF 16V RB electro
3	4.7uF 16V RB electro
9	10uF 16V RB electro
3	22uF 25V RB electro
2	330uF 25V (or 16V) RB electro
1	1000uF 25V RB electro
1	2200uF 16V RB electro
2	20pF trimmers

Resistors

All 1/4W carbon film: 1 x 22 ohm, 1 x 68 ohm, 2 x 100 ohm, 1 x 120 ohm, 1 x 150 ohm, 1 x 180 ohm, 4 x 220 ohm, 4 x 330 ohm, 1 x 390 ohm, 3 x 470 ohm, 1 x 560 ohm, 2 x 680 ohm, 11 x 1k, 8 x 1.2k, 3 x 1.5k, 3 x 1.8k, 2 x 2.2k, 3 x 2.7k, 3 x 3.3k, 7 x 4.7k, 1 x 5.6k, 3 x 27k, 2 x 47k, 3 x 56k, 1 x 68k, 1 x 82k, 2 x 100k, 1 x 150k

1	1k mini horizontal trimpot
1	10k mini horizontal trimpot
1	20k mini horizontal trimpot

Miscellaneous

Mains cable and plug, two way terminal block, DPDT switch, cable clamp and grommet, 4 rubber feet, lug for mains earth, 10cm spaghetti insulating tube, 8mm square red bezel, 11 x PCB pins, 2 x 28 pin IC sockets, 1 x 40 pin IC socket, 1 x 14 pin IC socket, 1 x 24 pin IC socket, tin shield for IR preamp, various nuts, bolts, screws, washers and spacers.

IR REMOTE TRANSMITTER

1	Aluminium black anodised front panel
1	Main PCB
1	Keypad PCB
21	Chrome keypad buttons
1	Keypad membrane
1	Case assembly (two halves) and window
1	455kHz ceramic resonator

Semiconductors

1	SAA3004 encoder IC
1	BC639 transistor
2	LD271/LTE-4208 IR emitting diode

Capacitors

1	56pF ceramic capacitor
1	120pF ceramic capacitor
1	220uF 16V RB electrolytic capacitor

Resistors

1	1.8 ohm 1/4W 5% resistor
1	100 ohm 1/4W 5% resistor

Miscellaneous

6	M2 x 5 cross head PK screws
1	M2.5 x 5 cross head PK screw
1	216 battery snap lead

Rainbow cable and thin insulated single strand wire.

for the muting function. It then passes to the RF modulator via C16 and via output buffer Q10 to the audio output.

Note that the emitter network of Q9 is to give pre-emphasis to the audio fed to the modulator, to allow for the de-emphasis in the TV receiver. To compensate for this pre-emphasis, where the direct audio output is concerned, there is a matching de-emphasis network in the emitter circuit of Q10. As can be seen, both modulated RF audio and standard audio are controlled by the muting.

The video signal is fed to input pin 27 of the SAA 5230 VIP chip (IC3), via the video buffer stage around Q4. The VIP chip automatically synchronises to it and strips the Teletext data from it. It also regenerates composite sync from the video input, this synch being used by the SAA 5240 EURO CCT chip (IC4) to match its Teletext display output to the current TV picture.

Teletext clock (TTC) and data (TTD) signals emerge from the VIP chip via pins 14 and 15 respectively, passing to the corresponding inputs of the SAA 5240 EURO CCT chip (IC4). The regenerated composite sync signal (VCS) emerges from pin 25, while pin 17 provides a 6MHz signal which is phased-locked to the VCS signal, for use as a system dot clock by IC4. Quartz crystal XL2 is used by the chip in an internal oscillator, to produce the latter signal.

The 13.875MHz crystal XL1 is used in another internal oscillator, whose output is divided by two and used to regenerate the 6.9375MHz TTC signal.

Actual operation of the EURO CCT chip IC4 is programmed from the 68705 CPU (IC8) via the I²C bus, which connects to pins 19 and 20. The EURO CCT stores Teletext page character information, after acquisition and error checking, in the 6116 RAM (IC5).

The RGB video outputs of the EURO CCT (pins 13, 14 and 15) are of the open-drain type, and are 'pulled up' – i.e., they produce positive polarity signals. The colour signals each pass

Continued on page 143

Broadcast band loop antennas – 3

In the last of this short series of articles, the author describes a tuned loop antenna capable of higher performance than the passive loop already described.

by NOEL S. ERBS

Having established the limitations of a long wire antenna, with and without an antenna tuner, and noted the superior signal-noise of a passive loop, experiments with tuned loops were begun, aimed specifically at weak stations. As mentioned in Part 1 of this series, the noise rejection of loops is limited to the *electric field* component radiated from such nearby sources as colour TV (line scan whistle), mains switching transients, sick fluorescent tubes, microwave ovens (ON-OFF hum), and telephone dialling clicks.

Unfortunately, a loop cannot distinguish between signal and noise if both are present as *magnetic field* components.

Reception of a signal of field strength E at frequency f, using an air cored tuned loop gives a recoverable signal V, which is predicted (Ref.1) by:

$V = 2\pi f(\mu o/Zo)E(ANQ)$ ....(1)

where μo = free space permeability
Zo = free space permittivity
A = loop area
N = number of turns
Q = tuned loop Q.

For a given station, this simplifies to:

$V = \text{constant} \times (ANQ)$ ....(2)

The three quantities A, N and Q are to some extent interdependent. Initial attempts to maximise V relied on large A, but this approach led to cumbersome loops of dubious Q. Increasing N can raise coil resistance, which lowers coil Q. Ultimately N is limited by the available range of tuning capacitance.

As a reasonable comparison, to get a given signal from the antenna, a tuned loop with buffer amplifier should be more compact than a single turn passive loop in the ratio 1/(NQ). A tuned loop is also more easily interfaced with typical receivers than a passive loop, because its signal is fed via an unbalanced line.

On the other hand, a tuned loop involves extra complexity, requiring a fixed DC supply, and, if remotely tuned, a stable variable DC supply. An antenna rotator may also be necessary for best results.

In practice

Initially, a manually tuned loop wound on a wooden frame to act as an RF field enhancer (Ref.1) was used with a National battery portable, and showed promise on weak stations.

Next, a manually tuned loop using 75 ohm coaxial cable with the shield cut at mid point and grounded (Ref.2) was tried, but without success. Whether the shield was earthed or not, no difference in the level of interference from mains

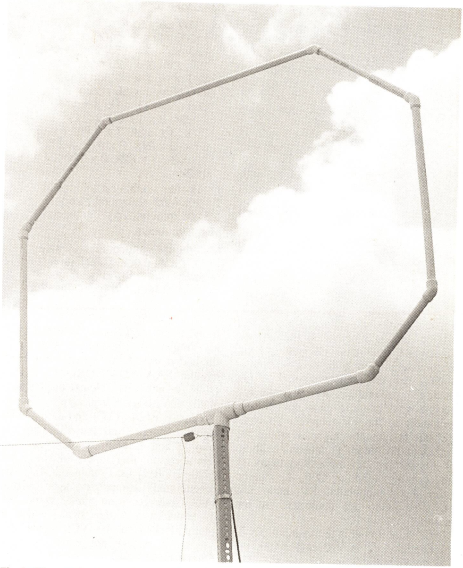


Fig.1: The author's self-supporting octagonal tuned loop.

wiring, fluorescent lights or a colour TV set could be detected.

Encouraged by a tuned loop antenna article (Ref.3), a self supporting octagon of PVC pipe, 1.5m wide x 1.3m high, was built and it is shown in Fig 1.

Four turns of 3 strands of 10/.0076" hookup wire twisted together were threaded through the tube. The octagonal shape was intended to approximate a circle and the paralleled conductors to reduce coil resistance at RF, both factors aimed at improving coil Q.

Remote tuning over a limited range centred on Sydney station 2KY (1017kHz) was achieved, by applying variable DC to a parallel combination of three 15V zeners and a 100pF polystyrene capacitor. A FET buffer stage connected to the receiver through 6 metres of 50 ohm coax. To equalise near field interference from surrounding houses, it was mounted at the rear of the garage, 5m above ground, edge-on to Sydney. The signal from 2KY with this antenna usually gave 2 to 3 LED's on the SONY, set to DX, in the early afternoon.

Poor conditions

Even when conditions were such that only traces of modulation could be heard using the long wire and antenna tuner, reception of 2KY was usually copyable, although with some effort. On some afternoons, however, propagation was so poor that one needed headphones and intense concentration to copy 2KY.

It must be stressed that at such times, no modulation at all could be heard through the background roar when using the long wire antenna, whether the antenna tuner was in use or not.

Adjacent stations

Background noise is the major factor in degrading audio, but adjacent station breakthrough can also be a nuisance. As a guide to this problem, 2KY Sydney on 1017kHz is sandwiched between 2XX and 3DB. 2XX Canberra, on 1008kHz at only 0.3kW always comes in more strongly than 2KY, and 3DB Melbourne, on 1026kHz at 5kW, is also usually stronger than 2KY.

One advantage of a loop in this case is that 3DB can be suppressed by orienting the loop broadside to Melbourne. However, this still leaves 2XX, which lies in the same general direction as 2KY and tends to break through.

At first, the Q of the octagonal loop seemed acceptable, because retuning was worthwhile if going the 18kHz from 2XX to 3DB. However, further trials showed the loop to be self-resonant at 1.2MHz from distributed self capacitance. This posed two problems:

(a) it was impossible to adapt this coil to full MW band tuning; and

(b) distributed self capacitance is known to degrade the Q of a coil.

No obvious solution to (a) existed and since high Q is vital to improve signal enhancement and overall selectivity, the design was abandoned.

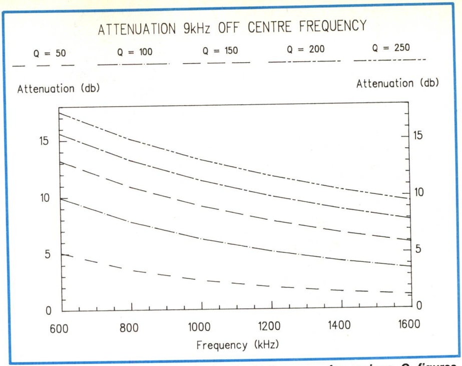


Fig.2: Variation in rejection of signals 9kHz away, for various Q figures, across the MW band.

It is worth looking at basic theory here, to see how much effect the Q of a tuned loop has on adjacent station rejection. Since the coil is buffered, the rejection in dB can be computed (Ref.6) on the basis of voltage ratio A/Ao according to:

$A/A_o = \geqslant 1 + Q^2[(f+df)/f-f/(f+df)]$

where f = nominal tuned frequency (kHz)

df = station spacing (9kHz).

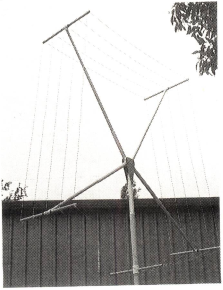


Fig.3: The author's pentagonal tuned loop, design to maximise L/R ratio.

The variation of rejection (dB) across the MW band is shown graphically for five values of Q in Fig 2.

As the 9kHz station separation becomes a smaller fraction of nominal frequency towards the top end of the MW band, the selectivity of a coil of given Q falls. To obtain 10dB attenuation at 1017kHz a coil Q of about 160 is required; a high figure, but not impossible.

Full range loop

Despite having to rate the octagonal loop unsatisfactory, I decided not to give up at this stage without pursuing the dual aims of high Q and remote tuning over the entire 531-1620kHz MW band. BB212 varicap diodes (Refs. 4 and 5) offer suitable specifications for remote coil tuning, although they are not cheap.

The coil shape which maximises L/R, and thus Q, is a cylinder with diameter to length ratio of approximately 2.4:1 (Ref.6). To see what a coil designed along these lines could do, a pentagon frame with PVC arms 1.3m long and fitted with 600mm end spreader bars was built to carry turns as shown in Fig 3.

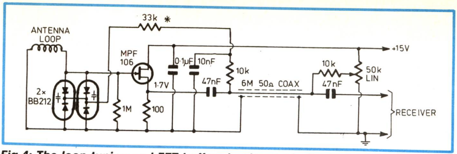


Fig.4: The loop tuning and FET buffer circuit used in the tests.

Initially 10 turns were wound on, in an unsuccessful attempt to resonate the coil with only one BB212. It was found that two BB212 varicaps in parallel could tune five turns over most of the MW band with a tuning voltage up to 10V. This coil required 36m of 24/0.20 wire with a measured resistance of 0.89 ohms. The FET buffer circuit is shown in Fig 4.

Signal from strong stations was clearly excessive and distant 50kW stations including 3AR, 3LO, 2FC and 2BL came in almost like local stations. The signal from 2KY was around 1 LED on NORMAL, but with little change in signal to noise.

The circuit in Fig.4 tended to go into RF oscillation towards the top end of the MW band, if the tuning control voltage resistor (*) was increased beyond 47k.

Copper tube antenna

A coil aimed to maximise Q, and hence signal level and selectivity, was built using 21m of 9mm copper tube salvaged from an oil heater line. It was wound and tied onto a 6 spoke wooden former. This 13.5T coil was 0.5m (ID) x 0.25m long. It had an end area of 0.196sqm and a measured DC resistance of 0.02 ohms. In contrast to the 24/0.2 wire, the tubular conductor was expected to exhibit low resistance at RF too.

Two paralleled BB212's could not tune this coil to the low end of the MW band. An extra 1.5 turns of copper tube were added and the coil was completed at 15mm pitch between turns, using fibreglass tape interleaved and wrapped at six points as in Fig.5.

The experimental FET buffer circuitry was then rewired onto a piece of Veroboard, cut to fit in an Ilford 35mm film canister as in Fig.6. The circuit was washed in alcohol, dried and dipped in polyurethane varnish to minimise future condensation moisture problems.

With 15 turns, tuning extended from below 549kHz to above 2MHz, the characteristic being graphed in Fig.7.

Compared to previous loops, the tuning of this one is remarkably sharp, so much so that it points up temperature drift problems. Even when using a stable power supply, re-tuning is necessary several times during the day in summer to keep weak stations at peak signal.

It is easy to identify the BB212's as culprits by artificially heating and cooling them. Heating increases their C and the voltage must be raised to retune; cooling has the reverse effect. The sharp tuning did not eliminate intrusion of percussive and sibilant audio from 2XX into 2KY reception.

Directional properties

The 15T coil was initially tested within a steel framed, metal clad building and it exhibited a deep null. When it was mounted 5m up on the end of this building, it was set broadside onto 2WG to suppress the strong signal from this local station. However, this alignment was also more or less broadside on to 3LO and 3AR, yet these two stations were received loud and clear!

The polar response was then checked, with the surprising result that it had little directionality when mounted

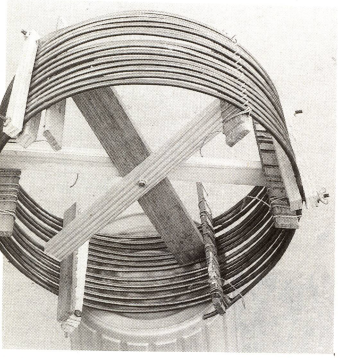


Fig.5: The completed 15-turn coil made from 9mm copper tube, salvaged from an oil heater line.

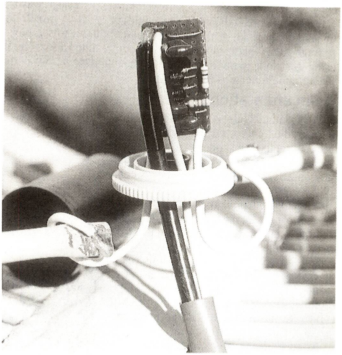


Fig.6: A closeup of the construction and mounting of the FET buffer stage.

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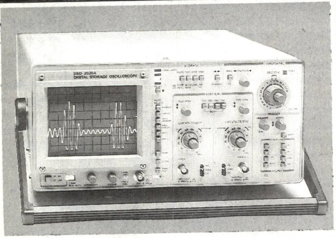

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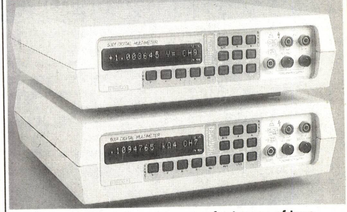

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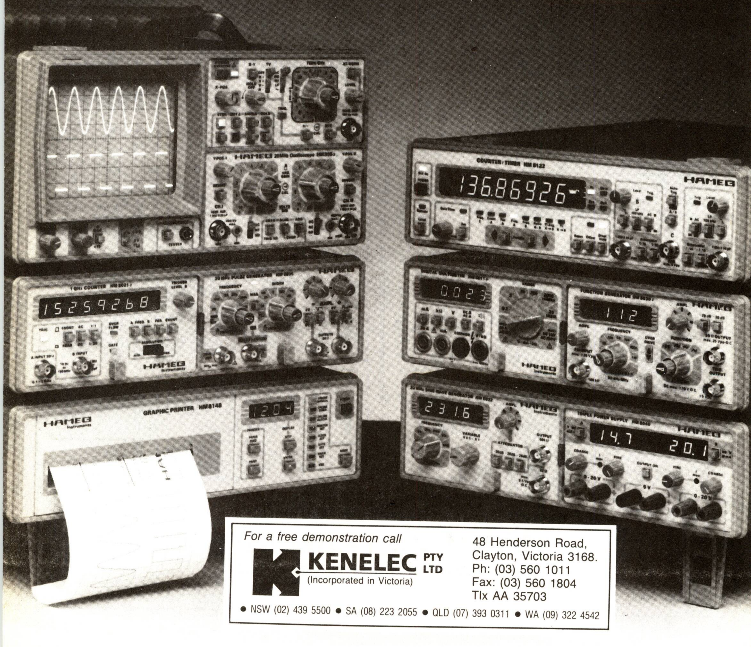

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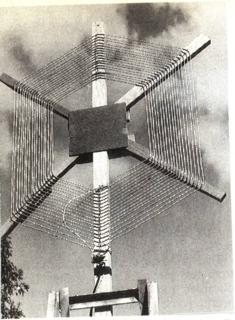


Fig.9: The author's 'spiderweb' coil, with 18 turns of 24/0.2 wire 570mm wide by 760mm high.

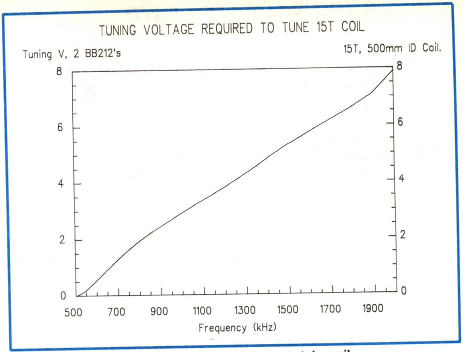


Fig.7: The tuning characteristic of the 15T copper tube coil.

5m up on the end of the building, as in Fig.8.

To check a theory that the finite length of the coil allowed signal pickup in all directions, a planar spiderweb coil was assembled, as in Fig.9. This has 18 turns of 24/0.2 wire, 570mm wide by 760mm high. The turns were spaced using nails at 10mm spacing on each arm.

By using 18 turns for this coil a single BB212 could tune the MW band. The fact that this coil has an area 1.7 times that of the copper coil and 20% more turns explains its extra signal output (compare Figs.8 and 10). It exhibited a deeper null when inside the building, but gave a similar reduction in directionality when mounted externally, as shown in Fig.10.

The polar plot comparisons are based on the AGC voltage of the AWA receiver, but the variations were generally supported by the LED array on the Sony ICF2001. I can offer no explanation for the observed loss of directional-

Continued on page 143

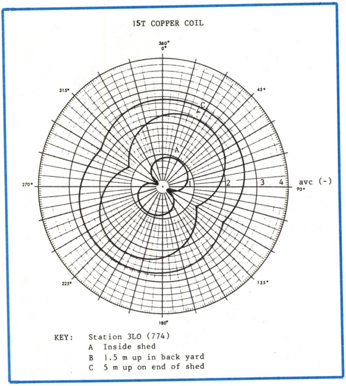


Fig.8: Polar response of the 15T coil made from copper tubing, in various locations.

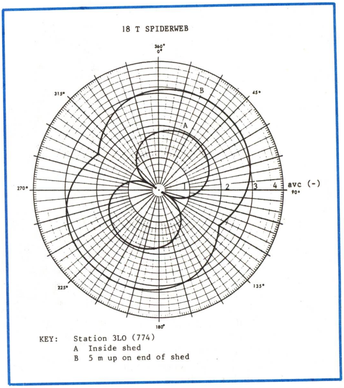


Fig.10: The polar response of the 18T spiderweb coil, for comparison. As before, best directionality was evident inside the shed!

Recreating your very own

'Spark': an old-time Induction Coil – 2

In the first of these articles the most difficult part of the induction coil was described – winding the primary and secondary windings, together with the iron core. The construction of the remaining components of the project will now be outlined, along with the overall assembly.

by PETER R. JENSEN, VK2AQJ

The next major stage of the project involves the construction of the interrupter, and again some idea of what is involved can be judged from the schematic and the photographs.

The main parts consist of brass sheet about 6mm thick and are cut to lengths to match the dimensions given. The major problem, once this is done, is to hold the pieces in position while they are soldered together.

In the end recourse was made to short steel pins (cut down nails actually) to hold everything in place. To set the pins in position, holes were drilled in the faces of the brass sheet which were slightly smaller than the diameter of the pins, which were then hammered into position. Before proceeding to attempt the soldering of the joints, apply a thin layer of solder to the mating faces. To do this a fairly substantial soldering iron will be required: something like a 'Scope'. With the thermal conductivity of brass to contend with, a lot of heat is required.

When this initial task of soldering has been completed and one comes to join the parts together, more heat than even the 'Scope' can provide will be required. If you are still on speaking terms with the resident 'Leader of the Opposition' and have access to a gas stove, then its heat output will be quite sufficient for the job.

In undertaking this work, be sure to avoid overheating the brass since it will oxidise and this makes it difficult for the solder to take. When the heat is just right it will be possible simply to apply the end of normal flux-cored wire solder to the joints and it will immediately melt into place.

Once all the joints have been run with solder the heat can be removed and the completed piece put to one side to cool. When at last you can pick up the cooled piece, it can be cleaned up and ground off to the desired shape, again following the diagrams provided. Drilling and tapping can then be undertaken to allow for the insertion of the rods and contacts.

The spring for the hammer was made from two pieces of steel binding tape discarded from a pallet of bricks, from a nearby house construction. Note that a good constructor has to be an unembarrassed scrounger too! This metal strap is quite springy, but not so hard that it could not be drilled – which, of course, is the next step. Here again the photographs and the schematic show how the two main parts of the interrupter were put together.

The last part of the assembly was the installation of some small pieces of platinum sheet on the face of the contacts. On a proportional or mass basis this was far and away the most expensive part of the whole reproduction since, at the present, this metal costs

The author playing old-time wireless operator, with some of his collection of original and re-created early equipment.

well over $30 per gram. This is probably a rather extravagant touch, but platinum is certainly far more resistant to the damage caused by sparking than brass or steel.

I used two small pieces about 0.5mm thick and 4mm in diameter, rolled out for me by a jeweller friend from a small piece of bar. The two pieces amounted to about 0.7 gram, and cost me just on $25. The two contacts were attached to the steel strips by silver soldering.

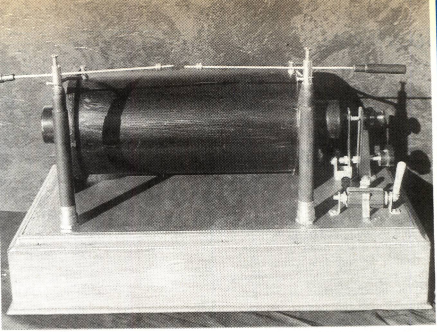
The next stage is to make the supports for the spark gap rods and the connection to the high voltage contacts on the induction coil. As may be seen from the photographs, the two supports consist of lengths of broom handle, preferably fine grained and dense in consistency. These are shaped at one end to fit neatly inside some standard brass plumbing fittings, and glued thereto with epoxy resin.

At the other end, the timber rods are drilled to take sections of brass rod, which are in turn drilled to take the spark gap rods. These rods are made from brazing rod and fitted with small brass collars near their ends, which are soldered into position once drilled to fit the rod. Again they were turned up on the electric drill from 6mm brass stock. The rods are also fitted with small wooden handles, which again are turned up in the chuck of the electric drill from 12mm timber rod.

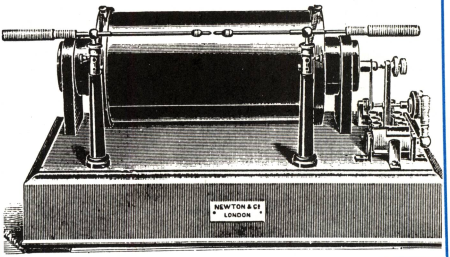
The last major assembly is the commutator, which is both the main switch for controlling the power supply and also allows reversal of the polarity of the power source. Again this consists of a section of timber run up in the chuck of the electric drill - mounted on a steel bolt with a couple of washers and a nut to serve as the spindle for this primitive lathe work.

When a nice symmetrical cylinder is completed, this is grooved to take pieces of flat copper strap, originally used as electrical earthing: more scrounging! The commutator is mounted on two sections of brass strap which, after annealing to make them less brittle, were bent into small brackets and drilled to take the centre spindle of the device.

Also required is a small handle, and this again can be turned up in the chuck of the drill from a small piece of dowelling. When the correct shape has been achieved the handle can be smoothed off with a piece of fine sandpaper. Finally to get a close grained finish, the wood is rubbed with another piece of timber while being run in the drill at speed. The timber can then be finished off with a little linseed oil or varnish.



Above is the author's completed Ruhmkorff Coil re-creation, circa 1989, while below is the original article made by Newton and Company in London, circa 1916.



The last major task of construction is to make the base. It would have been nice to have had some English oak to make this part of the reproduction but, in the end, Meranti (Pacific Maple) was used. It was also possible to match this timber with a piece of plywood for the top face of the base. The principal details of this base can be seen from the schematic, and the only area of difficulty is the moulding around the top and bottom edges.

For the top edge, a piece of standard 'reentrant section' quadrant moulding is used. When cut out and fixed into position, the top edge is planed and rolled to change it into an 'ovalo' shape. While this may sound tricky, in fact it turns out to be quite easy and the resultant moulding is almost indistinguishable from the genuine article.

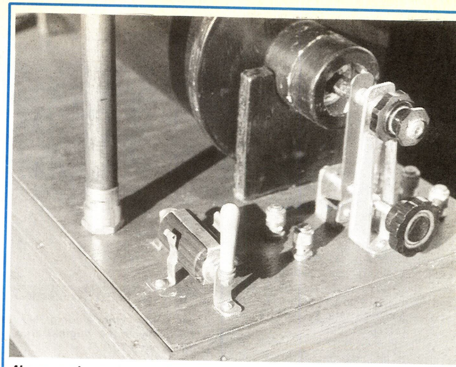
The bottom mould was made by slicing a standard 'double bull nose' batten down the middle, and using half only. Again a small amount of planing and sandpaper work will be required to achieve the proper roll to the exposed edge, when the batten is nailed into position. Incidentally all joints were mitred in a wooden mitre box and then the base was nailed and glued together with 'Aquadhere' PVA woodworking adhesive.

When all the timber work has been completed, it can be sanded back with an orbital sander or a sandpaper block if you are feeling energetic. When all is smooth, the finished base can be stained with a spirit stain to achieve a dark colour which is closer to that of the preferred Oak. When the necessary drying time has elapsed, a couple of coats of Estapol satin matt plastic coating will achieve the proper finish to the timber.

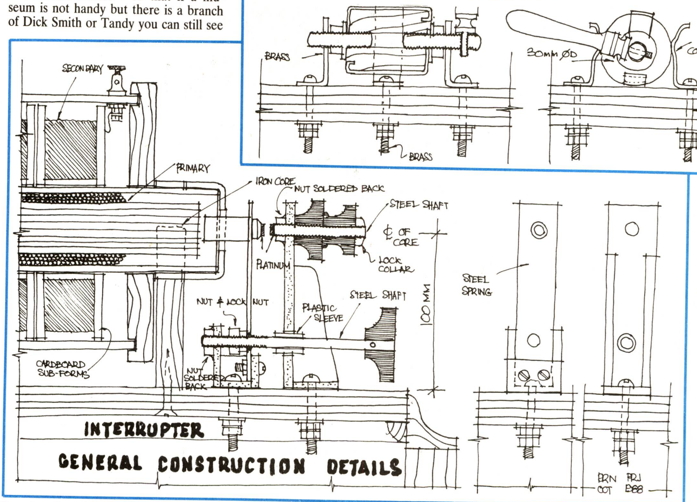
Before mounting the coil and its end plates on the timber base, it is as well to paint them up too. The paint used was a semi-gloss enamel black, and the plastic tubing needs to be sandpapered first to provide a key for the paint. When the surface of the plastic is a smooth and even satin texture then you know that the paint can be applied.

Incidentally if you don't use a spray can, then make sure that a fine bristle brush is employed or the brush marks will spoil the appearance. The original Ebonite material that you are trying to simulate had a very smooth and satiny appearance and is very difficult to describe: The front panel of many of the radios of the 1920's were made of ebonite, and can be seen in museums.

Stepping forward all of a hundred years, the covers of 5-1/4 inch computer disks are almost exactly the right colour and surface texture – so that if a museum is not handy but there is a branch of Dick Smith or Tandy you can still see



Above: a closer view of the polarity-reversing and on-off commutator switch and interrupter section of the coil. Construction details of the commutator switch are shown in the sketches below.



Construction details for the interrupter mechanism, with end views of the two brackets and spring shown at right. Note the adjustments for both the spring and the fixed contact.

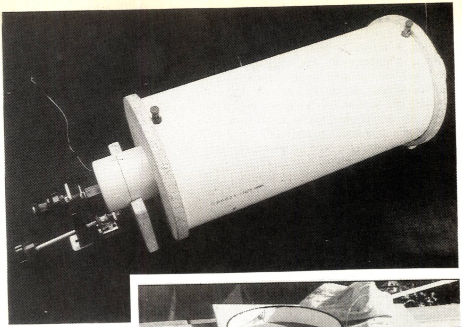
a model of what is required!

Once all the parts are dry they can be mounted in position on the timber base. Again reference to the schematic is essential in order to achieve the correct layout. The same applies to the wiring up, which should be copied exactly. The wiring diagram is scarcely as difficult to follow as the wiring diagram of even the most simple solid state device, but point to point wiring in household copper wire is probably a skill confined to electricians these days.

There is one other small but vital component to be added as a part of the wiring up process: This is the capacitor, or 'condenser' as it used to be called, which must be connected across the interrupter terminals. A value of about 2 microfarads is about right and a suitable component, with a working voltage of about 250 volts, (remember that 'back EMF') can be obtained from Sheridan Electronics at Redfern.

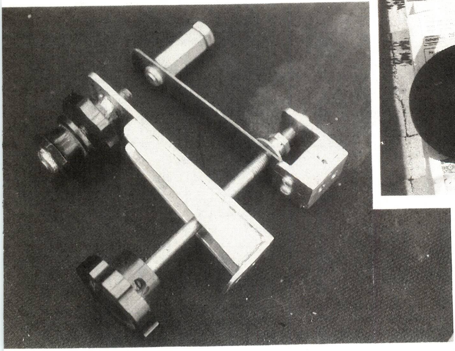
In reality this is the only modern component in the reproduction induction coil, but the construction of the genuine 2uF condenser proved so tedious that it was abandoned. The purpose of the condenser is to reduce the sparking-over that otherwise would occur at the platinum contacts, due to the back EMF, and to increase the secondary voltage pulse at the break of the interrupter.

Now at last when all the parts are bolted or screwed into position and all the wiring hooked up, power can once again be applied, the handle of the commutator rotated and, if everything is working correctly, a continuous spark



Above: The basic induction coil assembly made up, before painting.

Right: After the painting. Allow plenty of drying time before the final assembly.



Left: A close-up of the interrupter parts, showing details of the fabricated brackets, spring and armature. The silver-soldered platinum contacts are also visible.

will appear across the spark gap.

Some adjustment to the interrupter may well be required until a smooth and continuous action is achieved. In addition the tension on the spring may have to be 'fiddled' with until the proper pulsating action is achieved.

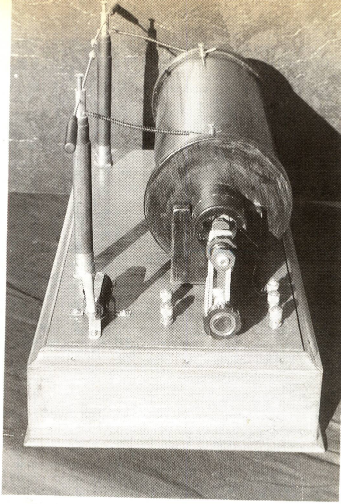
When everything is working properly, the exposed brass fittings can be coated with clear varnish to stop them tarnishing and you can take a well earned rest, knowing that you have constructed one of the most important elements of the first method of radio-communication, Spark Wireless Telegraphy.

Once again bear in mind that this device produces a very high working voltage and the spark can jump a very considerable distance.

If you happen to be the lowest impedance path available between the electrodes, that high voltage will have no hesitation in using you as the conducting medium. Then if you are lucky it will merely be a massive jolt that you feel: be warned. However do not be dismayed by the thought of 200,000 volts or so. If Marconi could play with such a device and survive then no doubt so can anyone.

Finally, I would like to extend my thanks to the Marconi Company of Chelmsford, England who gave access to archival records and apparatus and also supplied original photographs.

Happy constructing!



Another view of the completed coil, showing the main spark gap electrodes, commutator switch and interrupter adjustments.

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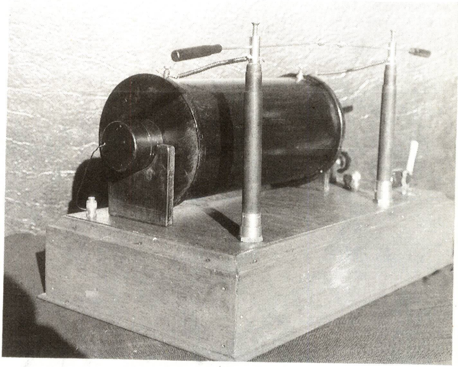

Finally, a view showing the main spark gap again, plus the 'other end' of the coil itself. Note the 'curly' wires from the coil secondary terminals to the spark gap electrode mounting posts.

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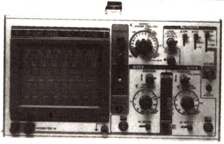

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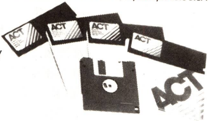

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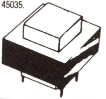

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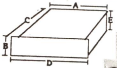

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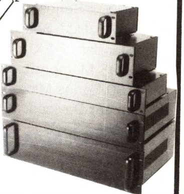

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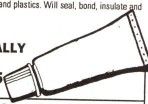

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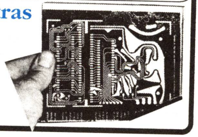

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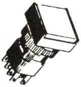

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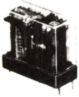

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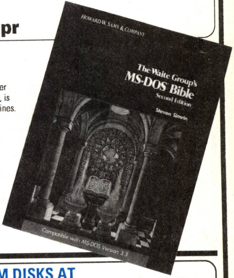

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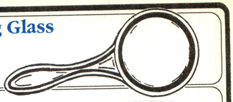

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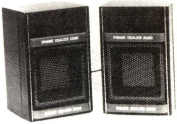

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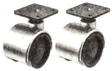

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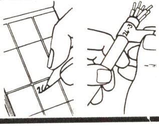

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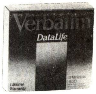

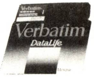

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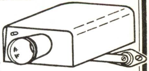

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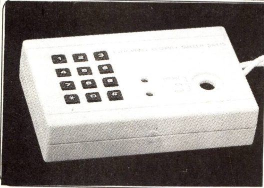

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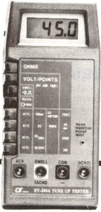

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Dimensions 130 (approx) dia
40(approx) deep
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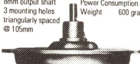
3 mounting holes
triangularly spaced
@ 105mm

SPECS

Speed	1800 RPM @ 12V
Torque	1.5kg/cm @ 1800 RPM
Power Consumption	70W @ 12V
Weight	600 grams



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Ref: EA April 1989

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It's a great way of having the space benefit of high performance book-shelf speakers with thundering bass down to 30Hz!

The Jaycar kit includes all specified components, metal case and Scotchcal panel.

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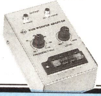

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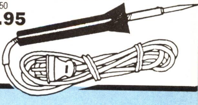

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- **4 Square Recess Bits No. 0, 1, 2 & 3**
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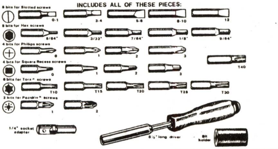

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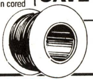

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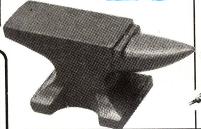

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Cat. HB-5410	Black	44	34	38	$65	$62
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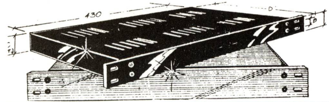

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An introduction to hifi – Part 23

Other types of Loudspeaker

Ribbon, piezoelectric, ionic and capacitive tweeters – full-range electrostatic transducers.

Earlier discussion of conventional moving coil loudspeakers and systems leads naturally to a brief survey of other types of transducer which have gained the attention of hifi enthusiasts over the years. Some of them remain largely as a memory, but full-range electrostatic loudspeakers have earned an important place in the domestic hifi scene.

by NEVILLE WILLIAMS

If space were no object, it would be interesting to delve back into the '20s and be reminded of the struggle to win a little more volume and a little more clarity from wireless broadcasts of the era. There were deluxe horn speakers that only the prosperous could afford, do-it-yourself ideas for optimistic experimenters, and the coveted 'Blue Spot' cone loudspeaker that became the flavour of the year, just before dynamic loudspeakers took over. But that is best set aside for another occasion.

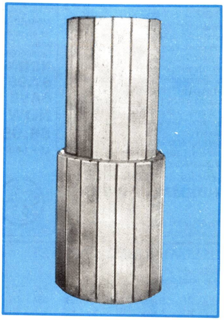
It is perhaps sufficient to note here that, in a situation completely dominated by moving-iron horn and cone loudspeakers, forward looking enthusiasts were thinking up and patenting quite different approaches that held promise of greatly improved fidelity. Some of their ideas were to remain dormant for 20 years or more until improving disc technology, tape recording and FM broadcasting encouraged another generation of enthusiasts to resurrect, update and launch them on to the hifi market.

Hifi enthusiasts from the '50s, for example, will probably recall the highly regarded Kelly 'ribbon' tweeters. Originally the brainchild of German inventors Schottky & Gerlach, the electromagnetic ribbon transducer was covered by a Siemens & Halske patent back in 1923 – a few months ahead of the better known 1924 Rice & Kellogg patent for the moving coil loudspeaker, as already discussed. The two are basically similar in principle.

As indicated in Fig.1, a flat metallic ribbon, which has been likened to a single-turn voice coil, is suspended lengthwise between the pole faces of a field magnet. When fed with audio current, the ribbon vibrates back and forth, moving air and creating sound waves in the process – without the assistance of a separate diaphragm.

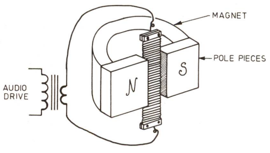
(As such, it was/is the converse of the ribbon – or so-called *velocity* – microphone, where sound waves excite a very thin ribbon and generate signal currents which can be fed to an amplifier, usually through a step-up transformer).

The ribbon was most commonly made from aluminium foil, transversely



This omni-directional electrostatic loudspeaker was designed by Peter Walker in 1955 – one of several prototypes produced and demonstrated about the same time. Modern electrostatics have a reputation for very clean, open sound.

Fig.1: Illustrating the basic principle of an electromagnetic ribbon transducer. Lacking the versatility and ruggedness of the moving coil system, was used mainly in tweeters – an application that is now dominated by dome cone dynamics.



crimped as shown to make it behave like a spring.

Mainly because of the wide magnetic gap between the pole faces, ribbon loudspeakers tend to be relatively insensitive, compared with normal dynamic cone drivers. The ribbon is also rather vulnerable to physical damage, during transit or if exposed to strong external air currents.

The best known application of the principle was as a tweeter by Stanley Kelly, in the British postwar hifi boom of the '50s (see Fig.2). Manufactured by Romagna Reproducers Ltd of the London, the Kelly ribbon tweeter relied on a 'catenoidal' horn at the front to improve acoustic efficiency, and a sealed and filled cavity at the back to provide rear sealing, acoustic loading and physical protection.

A built-in matching transformer stepped up the very low impedance of the ribbon to a more convenient 15 ohms, allowing it to be used in conjunction with a moving coil woofer and a conventional frequency dividing network.

Lacking a normal cone and suspension system, it was relatively free from resonance effects. In fact, the Kelly tweeter became almost legendary in its day for its smooth sound. It had a claimed response of 2.5 to 25kHz, but a maximum power rating of only 10W – a figure that may have been adequate for the period but scarcely so for modern systems and program sources.

For old-time enthusiasts, the Kelly style electromagnetic ribbon tweeter is now but a memory even if, for some, a fond one!

For the most part, its role has been taken over by dome type dynamic tweeters (chapter 21) or by elongated coated plastic ribbon transducers using electrostatic drive (see later section). One such, in the huge American Magnepan MGIII system (1983) was housed in a wrist-thick tube about 1.5m long!

The still current Technics 'leaf' tweeter, referred to in the last chapter, is another interesting adaptation of the original concept. Using a small, rectangular diaphragm suspended flexibly in a magnetic air gap, it operates typically in conjunction with a 25cm diameter honeycomb woofer and an 8cm squawker, rated to handle program signal peaking to well over 100W.

Piezo loudspeakers

The bending and twisting properties of certain natural or processed ('ceramic') crystalline substances has been widely used as a basis for 'crystal' or 'piezoelectric' pickups and microphones, with mechanical movement being translated into an electrical signal, capable of subsequent amplification.

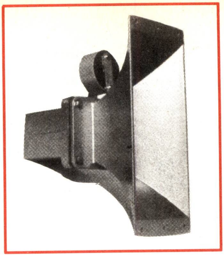


Fig.2: Probably the most popular-ever ribbon tweeter, originally designed by Stanley Kelly. Being sealed at the back, it could be mounted directly in the front panel of a bass/middle enclosure.

In the case of piezoelectric or 'crystal' loudspeakers, the function is reversed: an audio drive voltage is applied to a group of crystal elements (Fig.3), which bend or twist accordingly. The movement is transmitted to a diaphragm which produces sound waves in the normal way.

Piezoelectric loudspeakers do not lend themselves to the reproduction of low frequencies at a significant power level, because of the comparatively large physical excursions which are involved, and an ever-present risk of crystal fracture. As a result, they are most commonly used as the drive element for tweeters, complementing general-purpose moving coil transducers, which tend to roll off above about 6kHz.

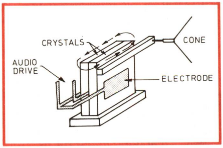


Fig.3: 'Crystal' loudspeakers rely on the fact that piezoelectric substances bend or twist or change dimensions rhythmically with the application of an audio drive voltage. Their main application has been as medium-fi tweeters.

For this role, 'crystal' tweeters are often fitted with short, flared (sometimes multicellular) horns, resulting in a comparatively high acoustic efficiency.

An interesting variant, developed by Motorola, used as a driving element a ceramic tube of lead zirconate and lead titanate. About 5cm long, it changes length in response to an applied audio drive voltage, allowing it to drive directly a horn compression diaphragm cemented to one end.

The predominantly capacitive impedance of a piezoelectric drive element can present something of a problem in terms of amplifier loading and the provision of a suitable high-pass output filter. This, plus a naturally stiff drive assembly, a cone mechanism and a dispersion horn, all conspire to produce a somewhat 'peaky' high frequency response, complicated by incidental resonance effects.

Largely as a result, crystal tweeters have acquired a reputation over the years for a high frequency response which is 'forward' and 'strident' rather than 'smooth' and 'musical'. They have featured much more commonly in speech reinforcement and disco situations than in domestic hifi systems.

Ionic transducers

By contrast, the *ionic* transducer is unique in that it does not involve any physical moving parts – armature, coil, piezo element, ribbon or cone.

William Duddell demonstrated the feasibility of non-mechanical sound reproduction in the '30s, by modulating a carbon arc with signal currents from an amplifier. The development of a practical non-mechanical loudspeaker is, however, normally credited to Sigmund Klein of Paris, in the '50s. Taken up by Audax, it was known in Europe as the 'Ionophone' and in the USA as the 'Ionovac'.

As indicated in Fig.4, the audio drive source was concentrated in a small, specially shaped quartz-glass tube (Fig.4a) which narrowed internally, near the centre, to a very small orifice.

A quartz-glass plug, which fitted snugly into the rear of the tube, was tipped with a metal electrode, referred to as a 'kanthal'. Behind this was a 'brimistor' or heat-dependent resistor and, behind that again, an external contact electrode. A metallic ring around the outside of the outer tube served as an earthed 'counter' electrode.

The quartz glass cell was mounted in one face of a metal housing (Fig.4b)

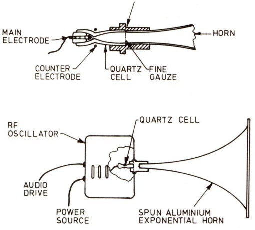


Fig.4: The French designed 'Ionophone' used no mechanical moving parts. An AM signal from an inbuilt RF oscillator caused ionisation and instantaneous air pressure variations in a quartz-glass cell (a) which are radiated as sound waves by an exponential horn (b).

containing a radio frequency (RF) oscillator, capable of being amplitude modulated by signal from the associated hifi amplifier. Operating in the 27MHz region, at a nominal power level of about 50W, the oscillator energised an extra step-up winding rather like the EHT coil in a TV receiver.

When the resulting high voltage RF energy was fed to the contact electrode on the ionophone, air particles surrounding the tip or kanthal were ionised, causing a 'glow discharge' and expansion of the air by heat in the open end of the quartz-glass tube.

If, as normal, the RF energy from the oscillator was modulated, the intensity of the glow discharge and the instantaneous air pressure in the quartz-glass cell would vary accordingly. An exponential horn served to couple these electronically induced variations in air pressure to the listening environment as ordinary sound waves.

On the plus side, the lack of moving parts obviated mechanical resonance effects, resulting in excellent transient behaviour and a potentially smooth frequency response. In practice, the overall performance was determined mainly by the linearity of the modulation system and the details of the horn.

As designed for tweeter service in the '50s and '60s, the Ionophone had a nominal response of 2-17kHz, with a distortion level that was said to be acceptable but not outstanding.

On the minus side, it tended to be less reliable and efficient than conventional transducers, more expensive, and more difficult to set up and use. As a further complication, the RF oscillator was also prone to create interference in other nearby electronic equipment.

The Ionophone (Fig.5) remains as an interesting example of transducer technology, but one that gained only limited support in the hifi marketplace.

Electrostatics

Electrostatic loudspeakers (ESLs) are the converse of 'condenser' or 'capacitor' microphones, being designed to produce sound waves rather than respond to them. They are simple in principle, as indicated in Fig.6, but certainly not in their practical implementation.

In their most basic form (Fig.6a) dating back into the '20s, they involve two adjacent but physically separate conductive plane surfaces, forming what is effectively a voltage-dependent air dielectric capacitor. One surface is rigid, the other sufficiently thin and flexible to permit limited to-and-fro movement – in this case at an audio rate.

When a DC 'polarising' voltage is applied across this virtual capacitor, the flexible conductive foil or membrane is attracted towards the fixed plate, but is prevented from actually touching it by the way in which it (the foil) is supported and tensioned.

Depending on the size and design, the intended polarising (or EHT) voltage, obtained from an external supply, may range from a few hundred to a few thousand volts. A high source impedance and/or series resistor limits the available current and minimises any trauma in the event of a momentary short circuit.

The inter-electrode capacitance may range from a few hundred to a few

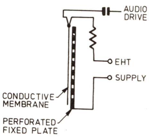
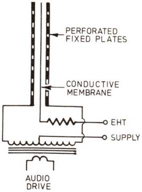


Fig.6: A basic single-sided electrostatic configuration (above), used in the '50s mainly for tweeters. Modern electrostatic loudspeakers invariably use the balanced configuration (below) to achieve better linearity and much lower distortion.



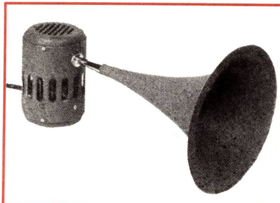


Fig.5: The Ionophone all-electronic tweeter, as marketed in the UK by Plessey. The horn was about 180mm in diameter and 240mm long.

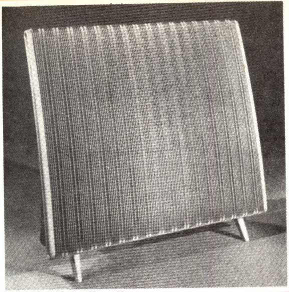


Fig.7: Still highly regarded by many enthusiasts for its smooth, transparent sound – the popular QUAD ESL. Power handling and deep bass response are borderline for present-day requirements.

thousand picofarads, again depending on the design of the particular unit.

If an audio signal voltage is also fed to the system, as indicated, the instantaneous audio voltage will add to and subtract from the DC polarising voltage, effectively varying it around its mean value. In turn, the electrostatic force will vary, causing the foil or membrane to move to-and-fro, relative to the fixed plate, so producing air movement and sound waves.

If considered necessary by the designer, fine perforations in the fixed plate can reduce the loading effect of air trapped between the two, allowing the flexible membrane greater freedom of movement.

A considerable number of simple and relatively inexpensive electrostatic tweeters using the above principle were marketed during the immediate postwar years, mainly for use with single-ended valve type audio systems. The polarising voltage was picked up from the 300V (approx) HT supply, and the high frequency audio drive from the output valve anode via a simple high-pass network.

Balanced form

In practice, the simple arrangement of Fig.6a poses a basic problem in that the electrostatic force tends to vary inversely with the distance between the two plates. As a result, sonic half-cycles produced as the membrane approaches the fixed plate are likely to be more prominent than those resulting from the reverse movement.

This inherent non-linearity was tolerated in unpretentious top-end tweeters, because the consequent distortion products were mainly second harmonic, falling close to or beyond the limit of audibility. But it was an unacceptable liability for hifi situations, especially in relation to transducers covering a wider frequency range.

Most modern electrostatic loudspeakers use the balanced or *push-pull* configuration of Fig.6b, with a flexible conductive membrane placed symmetrically between two perforated fixed plates. Not only does this overcome the basic unbalance, but the series impedance of the polarising voltage source and/or the resistivity of the membrane can be manipulated to further improve linearity and reduce harmonic distortion to a very small figure.

As indicated, the audio drive voltage can be applied quite independently to the outer plates, normally by means of an in-built centre-tapped step-up transformer, fed from the usual low-impedance amplifier output circuit.

Practical aspects

Behind the electrostatic approach is the expectation that a low mass membrane should be capable of exceptional high frequency and transient response. Furthermore, being flexible and driven more uniformly across its surface, it should hopefully be less prone to dominant resonance and vibration modes than conventional cones, with reduced tone colouration as a result.

Manufacturers face the problem, however, that electrostatic drive does not lend itself to compact design by the use of a small, long-travel radiating surface, as in compact moving coil systems. Adequate propagation of the lower frequencies can only be achieved by a progressive increase in the area of the flexible membrane, so that wide-range electrostatic loudspeakers are, of necessity, rather large – unacceptably so for many situations.

They also tend to be unduly directional in the propagation of mid and high frequencies, because of the larger than usual radiating surface. To overcome this and other design problems, wide-range electrostatic transducers commonly use multiple membrane assemblies, each optimised for different portions of the spectrum.

Whatever the approach, the designer has to devise a means of supporting the flexible membranes quite close to the relevant fixed plates, but in such a way that they will never touch them under high drive conditions, or under any normal stress or draughts in the listening room, or as a result of minor encounters with children or family pets!

The general approach is to stretch the flexible membrane across or around a rigid frame, which provides the initial separation from the fixed plates. This is supplemented, where necessary, by a pattern of resilient insulating spacers which provide multi-point support across the active area. An outer, acoustically transparent grille cloth and frame provide external physical protection.

By way of interest, readers might like to refer to two articles on the design and construction of electrostatic loudspeakers, written by A.A. Rendle and published in the February and March 1976 issues of *Electronics Australia.*

Typical electrostatics

On the Australian scene, the best known examples of high quality wide-range electrostatics have been the QUAD series, devised by Peter Walker and produced by the Acoustical Manufacturing Co of Huntington, UK.

Walker's first full-range model was exhibited at the London Waldorf in 1955. Standing about 5ft (1.5m) tall, it had a rated response of 40Hz-14kHz and, according to Gilbert Briggs of Wharfedale, sounded much better than either he or Stanley Kelly (of ribbon tweeter fame) might have found it politic to admit at the time. (*Loudspeakers*, G.A.Briggs, 5th Ed, Oct.'66, p.235)

The model which subsequently became well known in Australia is as pictured in Fig.7. Standing on three 9cm legs, it curved gently backwards in order to beam mid and high frequency sound up towards the listener. Overall dimensions were: 760 x 850 x 260 millimetres.

Photographs and a description in the abovementioned book indicate that a centre vertical membrane about 4.5cm wide covered the range above about 8kHz. On either side, slightly wider strips covered the range 250Hz-8kHz, while the two main outer panels handled the low frequencies down to a nominal 40Hz.

A step-up transformer and associated divider/feed components were accommodated on one side of the cabinet floor, and a mains powered EHT supply on the other. The unit was rated to handle the output of a 15W amplifier, with an efficiency about 3-6dB below that of contemporary high quality moving coil systems. Available acoustic output as a mono system was rated by Briggs as "more than adequate for domestic requirements".

A completely re-designed model, the QUAD ESL-63, typifies a more ambitious approach to the design of a full-range electrostatic loudspeaker. Released during 1982 and described in some detail in the June '82 issue of *Electronics Australia*, it measured 920 x 660 x 240mm – marginally larger than the earlier model, but of more conventional upright shape.

A vital difference is that the rigid outer perforated plates are of copper coated plastic, etched as indicated in Fig.8, to create seven concentric rings within the outer rectangle. The flexible membrane is 2 microns thick, with a very high-resistance coating, to prevent the distributed 5kV charge from 'migrating' dynamically under the influence of the drive signal.

The signal is fed to the annular rings through an audio delay line (Fig.9), designed to delay the signal by 24us per section. According to Peter Walker, the progressive phase delay from the centre outwards provides a smooth horizontal and vertical energy pattern, simulating that from a theoretical pulsating sphere positioned somewhat behind the acoustically transparent membrane.

The delay filter and matching transformer also help to modify the load presented by the system, from highly capacitive – and decidedly awkward for some amplifiers – to predominantly resistive, in the range 4-30 ohms.

ESL pros and cons

The foregoing should explain the earlier remark to the effect that, while electrostatic loudspeakers may be simple in principle, they are certainly not so in their practical implementation.

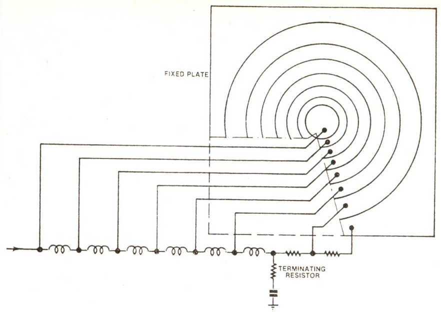


Fig.9: The delay line signal feed to each of the segmented outer capacitive elements in the QUAD EL-63. It optimises the sound propagation pattern and presents a much more convenient, predominantly resistive load to the associated amplifier.

Indeed, some critics question their overall cost effectiveness, drawing attention to their physical dimensions and the apparent vulnerability of the membranes to stress, wind gusts and excesses of temperature and humidity. They point to demonstrable resonance effects in the membranes between suspension points, and the likelihood that the outer electrodes may be neither completely rigid nor acoustically inert.

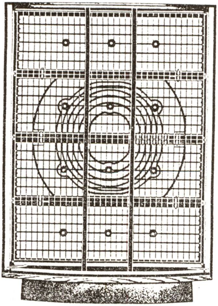


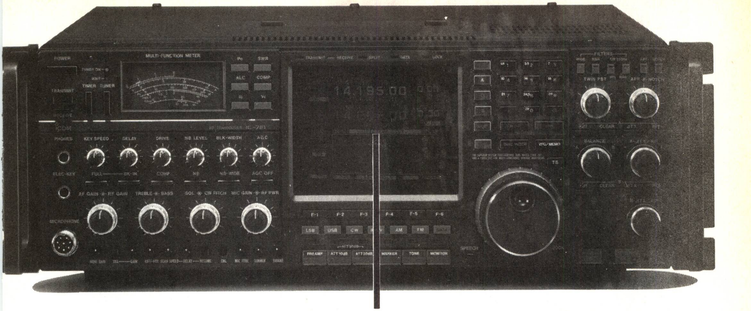
Fig.8: Typifying the advanced design of a modern full-range electrostatic, the QUAD ESL-63 uses segmented outer capacitive elements as shown.

While such reservations may have sufficient validity to ensure continuing majority support for moving coil transducers, they certainly do not deter the minority of enthusiasts and manufacturers who simply prefer what they describe as the 'open', 'transparent' sound of a well designed electrostatic transducer.

Perhaps the most serious criticism of normal full-range electrostatics is that, for all their considerable frontal area, they are still subject to the acoustic short-circuit effect at low frequencies (chapter 20). Air pressurised on one side of the membrane during a given half-cycle has time to move around the edge to the other side, instead of radiating outwards into the listening area.

Because of their size, however, they are not amenable to external baffling. The most practical answer, for those who seek that elusive bass sub-octave is to provide a supplementary sub-woofer using a suitably baffled moving coil driver. While adding considerably to the overall cost, such an arrangement combines the reputed qualities of an electrostatic transducer with extended bass response.

(To be continued)



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There is a built in 10-keyboard for easy operation. Or you can use the built in remote control communication interface-V system.

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For your nearest ICOM stockist, just call (008) 33 8915. And they'll tell you everything you need to know about the IC-781. Then once you've got one, the CRT display will tell you everything you need to know about what it's doing.

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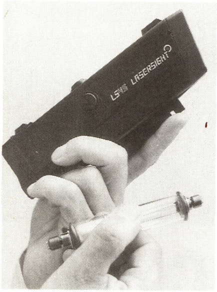


Compact He-Ne laser

Siemens is now offering a helium-neon laser tube whose diameter has been reduced from 25.0 to 22.5mm. Like its predecessor (LGR 7646) the new LGR 7656 is 119mm long; its output power in the basic mode (TEMoo) is at least 0.5mW at 2.8mA current consumption and 1000V operating voltage.

The low current consumption of 2.8mA now even allows helium-neon lasers to be battery operated. Apart from manual scanners for reading bar codes at checkouts, Siemens sees applications in construction lasers, ranging instruments and targeting aids for hunting and sporting weapons. The lightweights (70g) are also increasingly in demand for the leisure industry. Its operational life of 10,000 hours makes the LGR 7656 eminently suitable for laser pointers for use with projected images or graphics. Such optical pointers can now remain switched on during the entire presentation of a paper without needing to be concerned about the service life of the laser tubes.

For further details please contact the Electronic Components Department of Siemens, 544 Church Street, Richmond 3121 or phone (03) 420 7313.

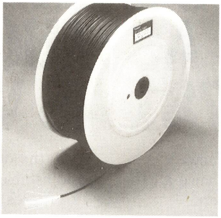
Low cost keyboards

The Component Product Division of IEE has announced the availability of a new series of cost effective 'Thriftswitch' keyboards.

The Series KS2585 keyboards feature rear panel mounting, black ABS bezels and double shot moulded keys (white on black legends are standard). Three popular output configurations are offered as standard, which include single pole/common bus, X-Y matrix and 2 of 7.

As with all Thriftswitch products the 2585 Series offers electrostatic shielding as a standard feature. The conductive rubber contacts are rated 5mA at 12V DC, with a maximum resistance of 200 ohms. The highly reliable key and switch mechanism offers a contact and legend life of over 1,000,000 actuations under normal operation.

For further information contact M.B. and K.J. Davidson, 17 Roberna Street, Moorabin 3189 or phone (03) 555 7277.



Low cost optical fibre

FORT is offering a range of low-cost plastic optical fibre that is ideally suited for industry, lighting and the hobbyist. A leaflet describing the fibre, together with a sample, can be obtained by sending a stamped addressed envelope to Fibre Optic Research & Technology, P.O. Box 231, Frenchs Forest 2086.

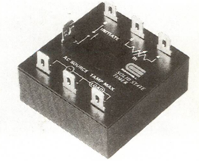
1.5GHz counter

The Lodestar model FC-5700A frequency counter/timer available ffrom Quiptek Australia is an 8 digit 1.5 GHz frequency counter with time base accuracy of +/−1 count.

The counter has a range from 10Hz – 1.5GHz using two separate inputs, 10Hz – 100MHz and 80 MHz – 1.5GHz, with sensitivities of 20mV on one input and 10mV, 80MHz – 600MHz and 35mV, 600 MHz – 1.5GHz on the other.

The FC-5700A is reliable, represents value for money and is intended fo professional use in maintenance, tes and service situations at technical colleges, universities and research institutions. The bench mount unit comes with instruction manual, carry handle, BNC clip and weighs 2.8kgs.

A detailed brochure is available by contacting Quiptek Australia, PO Box 159, Melville 6156 or phone (09) 330 6300.



Solid state timers

A range of small, easy-to-install, solid state cube timers is available in Australia. These inexpensive time delay relays offer a low-cost, reliable and long operating life alternative to the electro-mechanical time delay relay.

The timers are manufactured by Echowell, who ensure reliable operation by putting them through a 100% test before epoxy coating and again after curing. Digital timing circuitry provides a high time repeat accuracy, better time stability against temperature and voltage variation, fast recycle times and allows long time delays to be accommodated.

The timers come in five standard operation modes: delay on make, delay on break, interval, single shot and recycle. Time delays are adjustable either by built-in or external potentiometer, fixed external resistor or are factory preset. Time ranges from a few milliseconds to 10 hours are available. All timers can work from a wide range of input voltages and some models from AC or DC. Protection is provided by built-in varistor and RC snubber circuit.

Prices range from $14.00-$28.00 and brochures are available from Multicorp, 35 Wells Street, Redfern, 2016 or phone (02) 698 5238.

Snap-in capacitors

Siemens is offering aluminium electrolytic capacitors whose two spring contacts, which are bent at the tips are intended for snap-in mounting on circuit boards. The capacitors are finally secured in the solder bath.

The new snap-in terminals are spaced

for a 10mm pitch and are available for general applications at up to 85°C (B41303/B43303) or for higher requirements at up to 105°C (/B41503/B43503). The rated capacitances range from 68 to 47,000uF and from 47 to 33,000uF. Both designs have a fully isolated and welded can; the diameters range from 22 to 30mm, and overall heights are from 25 to 50mm.

A primary application will be switched-mode power supplies and other power supply units. These aluminium electrolytic capcitors have voltage ratings of 10 to 400V.

For further details contact the Electronics Components Department of Siemens, 544 Church Street, Richmond 3121 or phone (03) 420 7313.

Uniden 'pro' CB

Captain Communications of Parramatta has just launched the Uniden PRO 540e, a high performance yet moderately priced 27MHz CB transceiver.

The features include:

40 channel selector, including instant access to channel 9 and 19;

Dim control with manual over-ride for night driving;

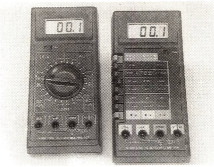
An SWR key to allow instant checking of antenna SWR;

Noise blanker and ANL key for best reduction of noise;

RF gain control;

A Signal/RF/SWR LED meter, providing an accurate 12 segment display of both transmitter and receiver functions.

For further information contact Captain Communications, 26-28 Parkes Street, Parramatta 2150 or phone (02) 633 4333.



DMMs have 20A range

The Hung Chang models HC5000 and HC6000 are 3½ digit general purpose digital multimeters. Both units feature identical ranges but the model HC6000 has an additional diode test facility.

The rotary range selector of the model HC5000 makes for quick range changing. Both meters feature 0.25% basic accuracy.

Specifications include:

DC volts – 5 ranges, to 1000V;
DC current – 6 ranges, to 20A;
AC volts – 5 ranges, to 750V;
AC current – 6 ranges, to 20A; and
Resistance – 6 ranges, to 20M.

The units are fully overload protected on voltage and resisitance ranges. The current ranges are fuse protected to 2A. Both meters come complete with high quality testleads and screw-on crocodile clips.

for more information contact Macy's Electrical Accessories, 8/9 Foamcrest Avenue, Newport 2106 or phone (02)997 8544.

Fax has error correction

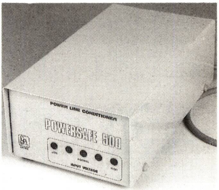
The new Toshiba TF-331 facsimile has an Error Correction mode which, in most cases overrides 'bad' lines and ensures transmissions are crisp and clear, so long as the recipent has a CCITT approved error correction facsimile.

Toshiba claims to be one of the first in the world to incorporate the CCITT mode, which has been officially sanctioned as an essential facsimile facility by the Geneva-based international Telegraph and Telephone Consultative Committee.

In addition to Error Correction mode, the compact TF-331 also has a Multiple Transmission capability enabling documents to be sent automatically to different locations. It also provides an Optical Mark Reader facility, giving the ability to enter pre-determined information into the unit, without using the keypad. The OMR Card also offers a safe and simple method of multiple after-hours transmission via a document feeder, thus eliminating 'collision factors' and offering more economical communication costs.

The TF-331's paper compartment holds a generous B4 size roll of recording paper (100 metres long) designed to give improved definition, especially of plans and artwork. And the unit can scan up to A3 to cope with most document formats. The document feeder itself holds up to 20 pages to allow a set-and-forget operation.

For further information phone Toshiba Australia on (02) 887 6034.



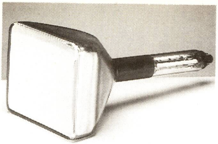
Power regulator

Component Resources has added the Powersafe 500 to its existing Powersafe 1000 and Powersafe 2500 range, all of which include a built-in power line filter for protection against line transients.

The Powersafe 500 guarantees to maintain output voltage at 240V +/−5% over an input voltage range of 189-283 VAC.

The humble 240 volt power outlet in some locations often carries as much as 280 volts and as little as 190 volts – seldom tolerated by much of today's electronics equipment.

For further information contact Component Resources, Dowsings Point, Hobart 7010 or phone (002) 73 0066.



Hi-res 17cm/70° flatface CRT

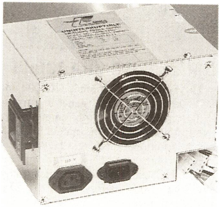
Philips Components is adding the plano-faced very high-resolution type M17-230WE to its range of 17cm monochrome CRTs. This new 70° flatface has been especially designed for high-end photorecording, such as medical; for high-definition television (HDTV) viewfinder applications; and for other display applications requiring outstanding picture quality.

The wide-diameter, high-voltage, bi-potential focus main lens reduces aberration to a minimum. In addition, internal multipoles shape the beam in such a way that, at a final accelerator voltage of 15kV, a spot of less than 0.005mm (50% brightness level) is obtained. This allows for images containing more than 2000 raster lines in photorecorder applications.

In HDTV viewfinder applications, where the image has a 9:16 aspect ratio, 1350 raster lines can be used at a luminance of 500Cd/M^2.

The tube has a useful surface area of 124 x 93mm and is 250mm long.

For further information contact Philips Components, 11 Waltham Street, Artarmon 2064 or phone (02) 439 3322.



UPS for PCs

Physically and mechanically identical to the standard power supply in IBM AT, PS/2 and 386 compatible computers, the Amtex uninterruptible power supply UPSA 4280-2 provides the computer's normal power supply requirements and battery back-up in the event of a power black-out.

When the power fails the UPS maintains power for 5 to 8 minutes, depending on load status – an alarm buzzer alerting the user to take the necessary steps to save data and close files etc. An 80 watt 50/60Hz output is provided to power the system monochrome or high resolution colour monitor. However an optional software and hardware package is available to perform these functions automatically, so that operator action is not required when the power fails.

Of power MOSFET design, the USPA 4280-2 delivers up to 200-230 watts of DC power for the motherboard, add-on boards and peripherals such as floppy and hard disk drives, as well as the 80 watts AC power for the monitor. The circuit design includes surge, over voltage and over current protection and an EMI filter is built-in.

The USPA 4280-2 is extremely easy to install and its internal maintenance-free battery automatically recharges within 8 hours.

Further information is available from Amtex Electronics, 13 Avon Road, North Ryde 2113 or phone (02) 805 0844.

Marine/land HF mobile transceiver

Capacity for 256 channels, approval for both marine and land use, and a host of other features give the SB250 high frequency synthesised transceiver the advantage over other comparable transceivers available in Australia, say the suppliers.

Barrett Communications of Perth, who manufacture and distribute the single sideband SB250, say their new product is also the only synthesised transceiver compatible with the ARQ radio telex system manufactured and distributed by Barrett Communications.

Features of SB250 include 100W PEP output; 12 volt operation; 512 frequency storage system; channel scanner; super-twisted liquid crystal display; automatic tuner interface; impulse noise blanker; analog volume and mute controls; digital clarifier; and high/low power selection.

Barrett Communications is at 10 Port Kembla Drive, Bibra Lake 6163 or phone (09) 418 4141.

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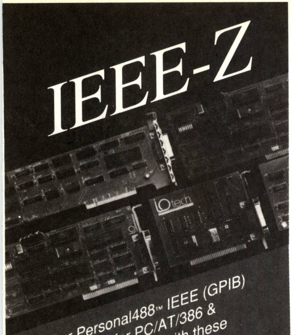

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Test Instrument Review:

Kikusui KSG4100 FM/AM signal generator

Over the last few weeks we've had the opportunity to try out the KSG4100, which is the lowest-cost general purpose model in Kikusui's KSG4000 series of microprocessor controlled 'synthesiser' PLL signal generators. It covers the frequency range from 100kHz to 110MHz, offering very stable output together with great operating flexibility.

by JIM ROWE

RF signal generators have certainly come a long way, in the last 30 years or so. I remember using one of the old AWA 'black box' signal generators not long after I left school, to align and test specialised communications receivers. It was built like a battleship, in a big cast aluminium box, and took two people to carry it if you didn't want to risk getting a hernia.

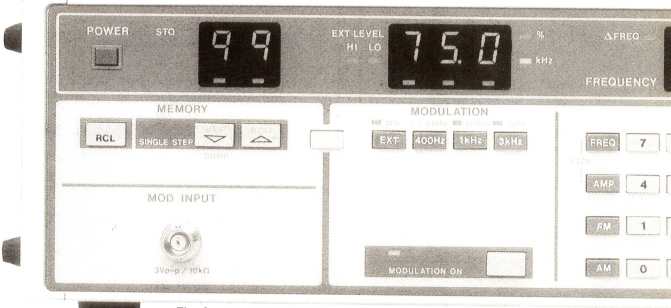
There was no band switching, as I recall; each generator was made to operate over a single band, and you used different generators for different bands. There was also no direct readout of frequency, just a graduated dial whose reading you had to compare with a chart to find the actual frequency. And since they used valves, you had to turn the generator on at least 15 minutes (preferably a lot more) before making your measurements, to allow it to become reasonably stabilised.

Once it did warm up and stabilise, it wasn't bad. Thanks to that massive case and heavy shielding, the leakage was very low and an elaborate attenuator gave quite accurate control of output level, well down to the 1 microvolt level.

At the time, it was quite impressive – and no doubt the equal of anything then made overseas, by famous test gear makers like General Radio. But by modern standards, it probably wouldn't even rate being called a signal generator.

This was well and truly driven home to me over the last few weeks, as I had the opportunity to try out one of Kikusui's current series of PLL (phase-locked loop) synthesiser signal generators, the KSG4100.

The KSG4100 is actually the simplest and lowest-cost model of the Kikusui KSG4000 series of generators, despite



The front panel of the KSG4100 generator is shown here about 80% of full size, to give you a good idea of the controls. The 6-digit display in the centre is for output frequency, with the main data entry keys and rotary control below it. At the far right is the output level display, with

the fact that its performance and facilities would put one of the old AWA black-box generators to shame. And also despite the fact that it probably weighs only about a quarter as much (6kg), and is housed in a case less than half the size: 430 x 118 x 305mm.

Like the old AWA generators, the KSG4100 covers only a single band – except that in this case, the 'band' extends continuously from 100kHz right up to 110MHz! In other words, from well below any of the usual IF and LF bands right through the MW and SW bands, past the television IF band and low band mobile bands, to beyond the FM broadcast band.

The resolution is in 100Hz increments up to 34.999MHz, and 1kHz increments above that. Output purity is high, with the second harmonic (the most significant spurious) being at least 30dB down on the fundamental. And the frequency stability is virtually that of a quartz crystal – within 5 parts in 10^{-5}.

Output flatness is within 1dB from 400kHz to 110MHz, with an only slightly wider tolerance of +/-1.5dB down to 100kHz. And the output level is adjustable over a total range of 118dB, from – 19dBu (near enough to 100nV) up to +99dBu (just below 100mV), with a resolution of 1dB. These figures are into an open circuit, but the KSG4100 has an output impedance of 50 ohms with a VSWR of less than 1.2 over the full frequency range.

When it comes to modulation, there is a choice of either AM or FM. Amplitude modulation up to 60% is possible, with internal AM facilities giving a choice of 400Hz, 1kHz or 3kHz and adjustment of from 0 – 60% modulation with a resolution of 0.5%. A default setting gives 30% modulation at the touch of a key. External modulation is also possible, at any frequency between 20Hz and 10kHz (response within +/-1dB); the input impedance for external AM is 10k, unbalanced.

AM distortion is less than 0.5% for 30% modulation and carrier frequencies between 200kHz and 30MHz, and less than 1.5% for other carrier frequencies.

For frequency modulation, any deviation is possible between 0 and 99.5kHz, with a resolution of 0.5kHz. There are also three fixed preset settings of 3.5kHz, 22.2kHz and 75kHz, and the same choice of three internal modulation frequencies as for AM. Again external modulation is possible, in this case with a bandwidth of 50Hz – 15kHz. The distortion factor for deviations of 1kHz or 75kHz is less than .05%, and less than 0.1% for other frequencies.

Incidentally a closely related generator, the KSG4110, provides virtually all of the features of the KSG4100 plus full stereo modulation capabilities (19kHz pilot tone).

So much for the basic generator functions provided by the KSG4100. But at this stage I haven't even mentioned the generator's very flexible operating facilities.

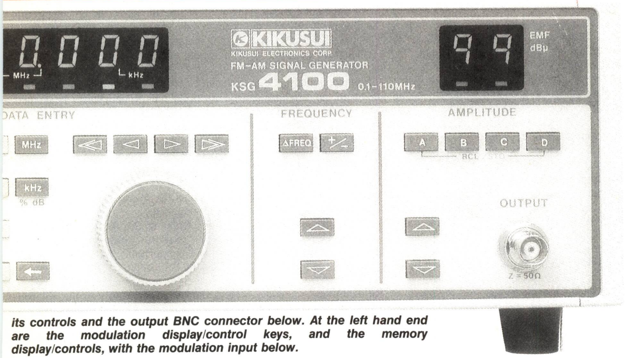
The key to these is that the KSG4100, like most of the latest generators (and for that matter, most modern test instruments as a whole) is microprocessor controlled. As a result, it is able to provide many really convenient control functions that previously wouldn't have been even feasible.

For example there's a 10-digit keypad, which can be used with a couple of mode keys to key in directly the desired output frequency, output level, AM modulation depth in percent or FM deviation in kHz. This is just the shot for quick setting up.

All main operating parameters are clearly displayed on bright 7-segment green LED displays, with a 6-digit group for the operating frequency, a 3-digit group for modulation %/kHz and a 2-digit group for output level in dBu.

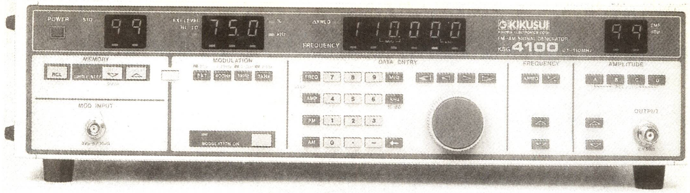
Of course incremental tuning is often preferable, as if you were tuning a conventional generator over a range. And with the KSG4100 this is just as easy. In fact you can adjust output level or modulation depth/deviation in the same way.

All you need do, to tune any of the digits for any operating parameter, is position an orange LED cursor under the display digit concerned and then simply turn the single master operating knob, either clockwise or anticlockwise as desired. The parameter concerned will then increment or decrement, in steps appropriate to the selected digit. And carry-over to the other digits is au-



its controls and the output BNC connector below. At the left hand end are the modulation display/control keys, and the memory display/controls, with the modulation input below.

Kikusui KSG4100 Signal Generator



tomatic, giving continuous control – very convenient indeed.

But what if you're checking the bandwidth of a tuned circuit, or the response of a filter? Here, you'd ideally like to set the tuning to the centre frequency, or some reference frequency, and then be able to adjust up and down from that point, in selected units of 'delta F'. The KSG4100 lets you do this too, and just as easily.

In this case all you do is set the centre frequency in the normal way – say 10.700MHz. Then press the 'Delta F' key, and adjust the frequency either up or down from the centre frequency in any desired steps – say 1kHz, or even 100Hz. The display automatically shows the relative frequency directly, making it very easy to plot bandpass curves and filter response characteristics. Pressing the 'Delta F' key at any time then flips the display back to normal absolute frequency again.

A further way that you can adjust the KSG4100's output frequency is in programmable increments or decrements, using the 'up arrow' and 'down arrow' keys. These can be programmed easily to produce any desired frequency step size – 500Hz, 1kHz, 5kHz, 9kHz or whatever you wish. This makes it very easy to check equipment that operates on channels of specific spacing, etc.

The same basic feature is available for adjustment of output level. Here you can program another pair of keys to increment or decrement the output level in 3dB steps, 6dB steps, 10dB steps or whatever – just the shot for plotting receiver AGC or overload characteristics.

Quite apart from this, the output level control circuitry has four independent level 'memories', each of which can store an output level setting at the touch of a key. So if you're doing a set of tests over and over again, in a production situation, four different output levels can be stored in the memories, and then recalled whenever you wish by pressing one of the four memory recall keys A, B, C or D.

But that's not all. The KSG4100 also provides – quite separately – a more comprehensive memory system, capable of storing 100 complete front-panel setups. Each of these setups can include frequency, output level, modulation on/-off, modulation mode and setting, and cursor position (for rapid adjustment via the rotary control). And the setups in memory can be recalled at any time either at random, using their particular address code (00-99), or in sequence using still another pair of up- and down-arrow keys to increment or decrement the memory address (which is displayed on a further pair of 7-segment LEDs).

The memory facility even allows you to store a 'RTN' code, allowing groups of settings to be recalled repeatedly.

This makes the memory facility an extremely powerful feature, which is capable of saving an enormous amount of time in production testing applications. And all of these lovely facilities stem from the fact that the KSG4100 is microprocessor controlled, of course. In fact it's an excellent example of the way that inbuilt micros are making our test instruments not just 'smarter', but a lot more flexible and convenient to use.

Incidentally the memory system is battery backed, so that stored settings are not lost when the instrument is turned off. In a factory situation there's no need to feed the settings in again every morning, for example.

At this stage I still haven't mentioned the optional remote control facility for the KSG4100, which allows just about all of its front-panel settings to be controlled from a distance. Or the memory dump/load facility, which allows all of its memory contents to be either copied into another KSG4100 generator, or downloaded from a master unit. Very nifty!

Trying it out

But what's it like to use? In a word, beautiful. The overwhelming feeling I had, while putting it through its paces was that here, at last, was the kind of RF signal generator we've always wanted. Stable as a rock (literally!), unambiguous in terms of front-panel controls and indications, and with the flexibility to perform almost any kind of RF measurement quickly and reliably.

Frequency accuracy and stability appeared to be well within the stated spec of +/-5 x 10^{-5}, and this even applied within about 30 seconds of switch-on from cold – most impressive. Longer-term stability seemed to be closer to +/-3 x 10^{-6}, in fact.

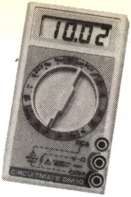
Similarly the output attenuator settings seemed to be well within the stated spec of +/-1dB between +20 and +99dBu, and +/-1.5dB between +20 and -19dBu – although our instruments wouldn't really allow us to check this rigorously. Modulation setting accuracy also seemed to be well within the stated accuracy of +/-5% for AM, and +/-10% for FM. Again we don't have the facilities to check modulation distortion accurately, but in both cases it seemed to be very low.

In short, then, our impression of the KSG4100 is that it's an excellent RF signal generator, and one that would grace any communications lab or production facility. For the quoted price of $3077 plus tax it seems very good value for money, also.

Our thanks to the Australian distributors for Kikusui, Emona Instruments, for the opportunity to try out the KSG4100.

Further information on the KSG4100 and the other generators in the Kikusui range (including the KSG-4500, with a range extending to 1.04GHz) is available from Emona at 86 Parramatta Road, Camperdown 2050, or phone (02) 519 3933.

FREE



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Technical Specifications

☐ Sensitivity 5mV/DIV-5V/DIV +/−3% 10 calibrated steps × 5 Mag.
☐ Bandwidth 20MHz(−3dB)
☐ Display Mode CH1, CH2, CH2 INV., ADD BOTH
☐ Impedance 1 MΩ/25pF
☐ Time Base 0.2uS/DIV−0.5S/DIV +/−3%, 20 calibrated steps × 10 Mag.
☐ Trigger Mode AUTO, NORM, TV
☐ X-Y Mode CH1-X Axis, CH2-Y Axis
☐ CRT 6 inch Rectangular, internal graticle with % scale

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Test Instruments Feature:

New Test Instruments

Source-measure instruments

Keithley Instruments has introduced a new 'source-measurement' instrument that for the first time makes this measurement technology practical and cost efficient for those in industrial test or research applications.

The Model 236 and 237 Source-Measure instruments can source and measure voltage or current simultaneously. They function as four instruments in one – DMM, electrometer, voltage source and current source. As one instrument, they are able to replace the cost and configuration time of those four separate units, and provide better co-ordination of source and measurement functions.

The 236 and 237 offer greater speed, accuracy and sensitivity than existing measurement methods. The Model 236 Source-Measurement instrument is able to source up to 110V, while its sister Model 237 can source voltage to 1100V. Both models are packaged as full rack instruments that are rack-mountable and ideal for ATE applications.

The units are high performance instruments, with the precision found in electrometers and the stability of high quality current/voltage sources.

For more information contact Scientific Devices Australia, 2 Jacks Road, South Oakleigh 3167 or phone (03) 579 3822.

Budget priced 1.5GHz counter/timer

The Lodestar model FC-5700A frequency counter/timer available from Quiptek Australia is an 8-digit 1.5GHz frequency counter with timebase accuracy of +/− 1 count. The counter has a range from 10Hz – 1.5GHz using two separate inputs, 10Hz – 100MHz and 80MHz – 1.5GHz, with sensitivities of 20mV on one input and 10mV, 80MHz – 600MHz and 35mV, 600MHz – 1.5GHz on the other.

The FC-5700A is reliable and is intended for professional use in maintenance and test and service situations at technical colleges, universities and research institutions. The bench mount unit comes with instruction manual, carry handle, BNC clip and weighs 2.8kgs.

A detailed brochure is available by contacting Quiptek Australia on (09) 330 6300 or by writing to PO Box 159, Melville 6256 WA.

Integrated thermometer-printer

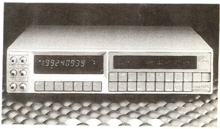
The AP-700 series thermometer printer is the latest addition to the Anritsu range of multi-function thermometers. This compact integrated printer thermometer can provide instantaneous temperature data and a printed record, including the date of the reading.

Features of the new printer include:

- Compact size – weighs only 350 grams.
- Displays all data: temperature, lapsed time, print interval, date.
- Five print intervals from 3 sec to 60 min. (Model AP-710)

The printer is supplied with a robust carrying case.

For further information and prices contact Electromark, 43 Anderson Road, Mortdale 2223 or phone (02) 570 7287.



Premium systems DMM

Datron Instruments has introduced the model 1271 – a Premium Systems DMM optimised for military and aerospace test applications. It joins the highly successful 1281 Standards Laboratory DMM as part of Datron's SELFCAL range.

DCV and IEEE 488 bus control are fitted as standard, with individual ohms, ratio, DCI and ACI options and two versions of ACV available, to produce unrivalled combinations of performance and price.

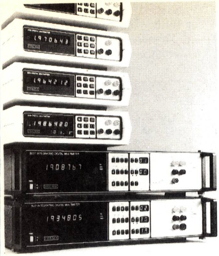
High accuracy is provided across all functions, with scale lengths from 5½ to 8½ digits and resolutions of 1 part in 200 million. Line interference is rejected using a continuous line-locked A-D technique.

On DCV, inputs from 10nV to 1kV are processed by a pre-amp with an input impedance of greater than 10G ohms for inputs up to 20V, a temperature coefficient of less than 0.1uV/°C and a long term stability of 7ppm/year.

For more information contact Scientific Devices Australia, 2 Jacks Road, South Oakleigh 3187 or phone (03) 579 3822.

Precision DMMs

Emona Instruments has been appointed distributor for Prema Precision Electronics, the West German specialist manufacturer of high resolution digital

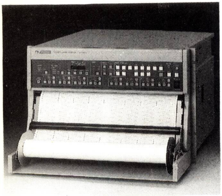


multimeters.

The Prema range covers 9 DMMs, in two basic series. Firstly there are the 6-½ digit bench-top models. Affordably priced, this series brings high accuracy and high resolution DMMs within the budget of general workshops and labs. Secondly, there are the advanced system units intended for calibration laboratories. These offer resolutions of 6-½, 7-½ and 8-½ digits.

Each DMM incorporates Prema's own patented technique for analog to digital conversion, known as the 'multiple ramp technique'. This technique is the basis for the Prema's outstanding linearity and long term stability, and immunity to noise, resulting in an extremely stable display.

Further information is available from Emona Instruments, 86 Parramatta Road, Camperdown 2050 or phone (02) 519 3933.



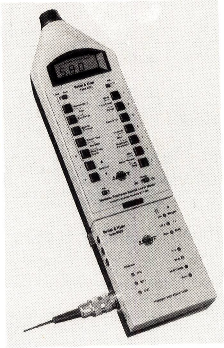
Thermal arraycorder

The new WR3600 Mark 10 is capable of recording eight 40mm wide channels of DC to 10KHz data. There are three modes of operation – direct, transient, and logging, selectable by a single keystroke. 32K of memory per channel is provided. The recorder prints a timing and amplitude grid simultaneously with the data, and a selection of six grid formats is available. Full control of channel width and trace expansion 8 to 80mm or 160mm is by front panel input.

The Mark 10 offers 44 pre-set chart speeds ranging from 0.01mm per minute to 200mm per second. There are 15 sample rates, ranging from 2k through to 100k samples per second, selectable from the front panel.

The Mark 10 uses either 397mm x 100m roll or 200m Z-fold paper. All paper is accommodated within the recorder housing. Dimensions are 439 (W) x 267 (H) x 447 (D)mm.

Further information is available from AWA Distribution, 112-118 Talavera Road, North Ryde 2113 or phone (02) 888 9000.



Vibration measuring set

Human-vibration Unit Type 2522 and Human-vibration Module BZ7105, just released by Bruel & Kjaer, combine with Modular Precision Sound Level Meter Type 2231 to form a dedicated and portable human-vibration analysis set which can measure simultaneously in up to three channels. It is ideally suited for the monitoring of human-vibration for the assessment of health risk such as Raynaud's phenomenon (vibration-induced white finger).

A digital data store allows storage of measurement data in up to 99 records, either automatically at user-defined intervals, or manually. Data can be simultaneously recorded on a level recorder or stored in the data store for subsequent hard-copy results in one of 5 formats. There is an easy-to-use facility for the recall of stored data to the display.

Frequency weightings comply with ISO5349 (for hand-arm measurements), ISO2631/1 (for whole-body measurements) and ISO/DIS2631/2 (for whole body combined measurements – designed for measurements of vibrations in buildings).

The set also has a facility for linearly weighting the signal over the specified frequency ranges for future analysis, such as 1/3-octave analysis (as recommended in the relevant standards). The set as a whole complies with ISO/DIS8041.

For further information contact Bruel & Kjaer Australia, 24 Tepko Road, Terrey Hills 2084 or phone (02) 450 2066.

DMM measures low resistance

WES Components has released the Lutron Model 6022A hand-held digital multimeter, capable of measuring resistance values as low as 0.01 ohms (+/−1%) and as high as 20M (+/−1.5%).

When measuring very low resistance levels even the test lead resistance is measured. The 6022A allows one to readily adjust the calibration to zero and hence get an accurate reading.

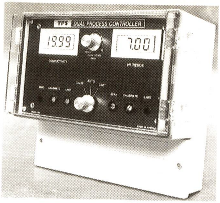
This battery-powered instrument has a low power consumption LCD display which warns of over-input and power failure. LSI-circuitry provides reliability and durability. The DC voltage measurement range is from 100uV to 1000V, while the AC voltage range is from 100uV to 750V. AC/DC current range is from 100nA to 20A. Overload circuit protection is provided.

The Lutron 6022A is available for $129 from Wagner Electronic Services, 305 Liverpool Road, Ashfield 2131 or phone (02) 798 9233.

SMT test debug accessories

Emulation Technology of Sunnyvale California offers easy emulation pods and adapters, a complete line of debug tools, PAL/PROM programmer adapters, quick and fast socket conversion, quality debugging accessories and over 150 prototyping adapters, for testing VLSI or SMD components.

Contact Current Solutions, 12A Church Street, Bayswater 3153 or phone (03) 720 3977, for more information.



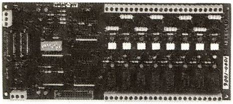
Conductivity, pH controller

The new TPS model HP2 is a dual controller, combining pH and conductivity in one unit. It can be customised to control any combination of conductivity or TDS, together with pH or Redox. The HP2 was designed for industrial and airconditioning applications.

The HP2 has separate LCD displays and is simple to use. All controls are easily accessible and clearly visible behind the clear, waterproof cover.

A 'Timed Addition' function is also a standard feature. An adjustable timer can be set to limit addition times, providing for optimum control. The timer can also be switched off for continuous control.

The HP2 is manufactured in Brisbane. Further information is available from TPS, 4 Jamberoo Street, Springwood 4127 or phone (07) 2900400.



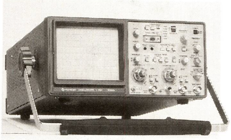
Digital I/O cards for PCs

Procon Technology now provides the widest range of digital I/O boards for the IBM-PC available in Australia. The PC-IO-XX series of boards operate through the parallel printer adapter port on any IBM-PC or compatible. Up to 15 I/O boards may be connected externally to the computer, providing 240 digital I/O points.

Within the range are long-life relay outputs (NR) suitable for general-purpose control applications and audio/video (CCTV and composite video) switching; high current relay outputs (DK), capable of switching 240V AC at 10 amps; and the latest solid-state relay outputs (DP), capable of switching 20-310V AC at 1 amp. Furthermore, socketed output boards (IC) are now available, capable of accepting most standard 6 pin opto-isolators or state-of-the-art photoMOS or photo voltaic relays (these solid-state opto-isolated relays switch up to 400 volts peak AC or DC with current capabilities of up to 0.5amps with excellent linearity).

The digital input options include; 12/24/48 volt AC or DC inputs, high-speed DC inputs (user configurable voltage and speed) and TTL level inputs that are fully isolated.

For further information contact Procon Technology, Box 43, Essendon 3040 or phone (03) 336 4956.



100MHz, 60MHz scopes

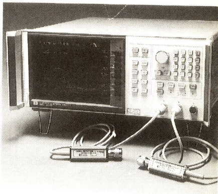
Bell Test & Measurement is pleased to announce the release of the Hitachi V1060 100MHz and V660 60MHz Compact Series oscilloscopes.

These oscilloscopes use the latest state-of-the-art IC technology, CPU control and digital sweep circuitry. Features include:

- CRT readout of A and B sweep, delayed sweep and hold off
- Sweep time auto ranging, with simple push-button selection. Sweep time is automatically set to optimum range, for display of 1.6 to 4 cycles on the screen. Manual range selection is also possible.
- Auto trigger level automatically tracks amplitude changes and sets trigger level to suit the waveform level.
- Dual channel input at 2mV/div sensitivity
- Compact and lightweight at 275(W) x 130(H) x 360mm(D), and a weight of only 6kg. This gives maximum performance in a compact design.

Both models offer a 6" CRT with internal graticule and 17kV for V1060 and 12kV for V660.

For further information contact Bell Test & Measurement Division, PO Box 14, Lidcombe 2141 or phone (02) 648 5455.



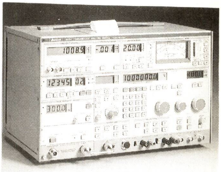
HP 8757A scalar analyser

Tech-Rentals has recently added the Hewlett-Packard 8757A Scalar Analyser to it extensive inventory, and now has it available for immediate rental.

This powerful analyser measures insertion loss and gain, return loss, SWR and power with ease and accuracy. It can be used to characterise the performance of microwave components and systems over the frequency range 10MHz to 60GHz.

The unit has four independent display channels and three detector inputs, which enables the simultaneous viewing of up to four measurement parameters at independent resolutions.

For further information contact Tech-Rentals offices in each state on, Melbourne (03) 879 2266; Sydney (02) 736 2066; Brisbane (07) 875 1077; Perth (09) 470 3644; Adelaide (08) 344 6999; and Canberra (062) 57 4983.



Radio comms analyser

Alcatel STC has announced a completely new comprehensive communications analyser. The MS555B Communications Analyser from Anritsu provides, in one compact and portable unit, all the test and measurement functions

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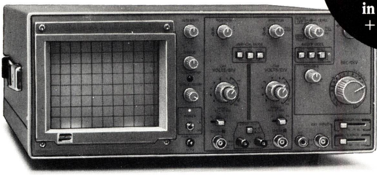

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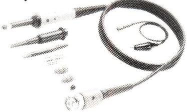

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needed to maintain narrow band transceivers and radio telephone systems.

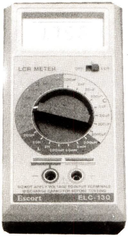
The MS555B covers a frequency range from 25 to 1000MHz and can measure fundamental receiver and transmitter characterisitics such as output power, frequency, FM deviation, sensitivity, signal to noise ratio and distortion. The inbuilt signal generator has excellent frequency stability and low residual noise. A self-contained microprocessor provides optional automatic measurement and data printing. An IEEE-488 optional interface is available to integrate the MS555B into a computer-contolled test system. An inbuilt printer to record test data is also available as an option.

For further information contact Alcatel STC Measuring Instruments, 58 Queensbridge Street, South Melbourne 3205 or phone (03) 615 6666.

Hand held LCR meter

Escort Instruments have launched the ELC130, a highly versatile 3-½ digit hand held LCR meter. Housed in a sturdy, hard wearing case, the unit features rotary switch operation for ease of use.

The ELC130 offers 3 functions; capacitance, inductance with dissipation factor and resistance. The specifications of the unit also offer the user a high degree of accuracy, with 0.5% for resistance and 1% for capacitance and inductance.



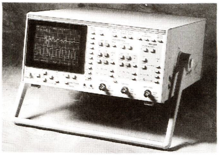
The capacitance range offered by the ELC130 is up to 2000uF with a maximum resolution of 0.1pF. The inductance range is up to 200H with a maximum resolution of 0.1uH, and resolution of 0.01 ohm on the 20 ohms range.

As well as a large, easy to read 3-½ digit LCD display, the unit features high quality plug-in sockets for component leads and standard 4mm probe terminals.

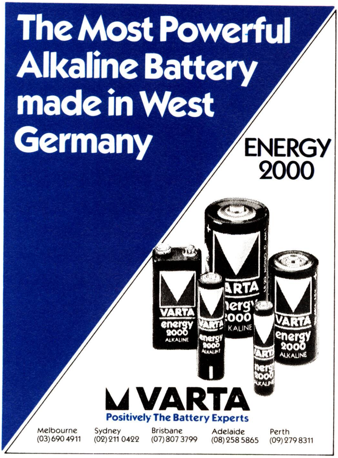
Further details are available from Emona Instruments, 86 Parramatta Road, Camperdown 2050 or phone (02) 519 3933.

100MS/s DSO

Low cost, high performance and portability meet in the new model 400 digital storage oscilloscope from Gould. The unit features a sampling rate of 100 Msamples/s on both input channels for single-shot capture with 8-bit amplitude, and 10ns time resolution. For continuous waveforms, the instrument uses random time sampling at an effective frequency of 500MHz, giving 2ns time resolution.



A powerful range of trigger capabilities is included. As an aid to capturing the meaningful part of a signal, trigger delays of up to 5000 seconds are avail-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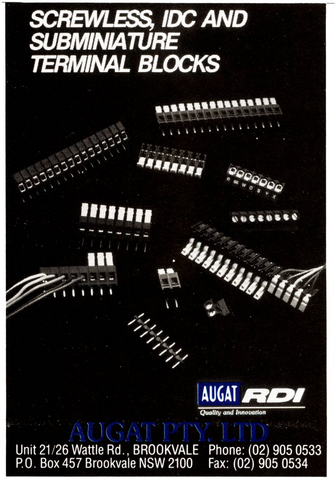
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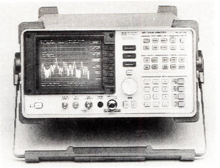
able with 20ns resolution, so that maximum use can be made of the high timebase sweep rates. In addition, the waveform leading up to the trigger point can be viewed using a pretrigger facility with a range of zero to 100%.

The model 400 digital storage scope measures 135mm high by 277mm wide by 389mm deep and weighs 5.5kg. The instrument costs $3595 excluding sales tax.

For further information contact any Elmeasco Instruments office on (08) 344 9000 Adelaide; (07) 875 1444 Brisbane; (03) 879 2322 Melbourne; (09) 470 1855 Perth; or (02) 736 2888 Sydney.

6.5GHz spectrum analyser

By using solid-state electronic switching, the new HP8561A spectrum analyser from Hewlett-Packard is the first RF analyser to provide continuous sweep capability from 1kHz to 6.5GHz. Tracking preselection extends from 2.75 to 6.5GHz, eliminating concerns about multiple responses or images when analysing high-frequency signals.



Portable and self-contained, the HP8561A is useful in field maintenance of commercial and military communication systems extending to 6.5GHz. The analyser simplifies mobile- and cellular-radio system analysis by measuring fundamental signals and their higher harmonics in a single sweep, thus eliminating the need for a more expensive microwave-system analyser often used to make these measurements.

Because several high-level functions have been included, the HP8561A facilitates field-mission applications. One function measures occupied power bandwidth of a signal. A fast Fourier transform function measures amplitude modulation and distortion, as well as amplitude modulation in the presence of incidental phase-angle modulation.

Further information from Hewlett-Packard Australia, 31-41 Joseph Street, Blackburn 3130 or phone (03) 895 2895.

100MHz programmable pulse generator

Tabor Electronics has just introduced its latest in a long line of innovative pulse generators. Microprocessor based, Model 8600 delivers 5ns pulses through two independently-programmed channels.

Some of its features include:

- Period range from 10ns to 2s
- Amplitude span from 0.5 to 5Vp-p (into 50 ohms)
- Pulse width range from 5ns to 4s
- Delay range from 0ns to 4s
- Pulse/Delay programming resolution of 1ns

The model 8600 incorporates a built-in counter. Basic accuracy is enhanced by utilising this counter in an internal closed loop, which measures and corrects the programmed period in real time. The need then for periodical frequency calibration is virtually eliminated, since the output is compared and corrected to a precise standard.

For further information contact Parameters, Centrecourt, 25-27 Paul Street North, North Ryde 2113 or phone (02) 888 8777.

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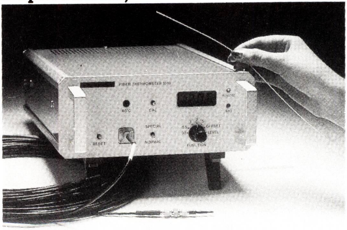

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New low-cost DMMs from Jaycar

These compact multimeters imported by Jaycar have pushed back the price barrier yet another notch, without compromising their features or quality.

While a digital multimeter (DMM) is one of the most fundamental pieces of test gear, it could hardly be called the most basic. Compared to a power supply or audio oscillator for example, the average DMM offers an enormous range of facilities in a very portable package. In addition to this, it seems that in the highly competitive DMM market, a drop in price can be associated with an even further increase in features.

Such is the case with the Jaycar QM1400 and QM1410 models shown below, which are offered at $99.95 and $59.95 respectively. The more expensive QM1400 is of particular interest, since in addition to the features normally found in a more expensive unit, it also provides a 200kHz frequency counter and a 20MHz logic probe. On the other hand the simpler QM1410 only includes the usual ranges found in a more basic DMM, but as with the QM1400, its price is very competitive.

Both instruments are housed in the same basic case, which is constructed of 'high impact' yellow plastic measuring 135mm x 72mm x 31mm. This compact case appears to be very sturdy, and includes a small T-section slot on either side, which mates to a matching protrusion on the test probes. These interlocking shapes allow the probes to either be stored on the side of the case, or mounted with the tips facing forward for single handed measurements. Alternatively, by attaching only the positive probe to the case and holding the negative probe to a common point, the meter conveniently becomes both the probe and read-out – all in all, rather a neat idea.

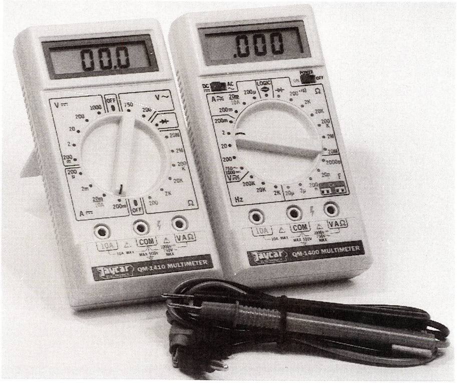
Another feature shared between the two models is a highly legible 3 1/2 digit liquid crystal display (LCD), with 10mm high digits and a low battery indicator. A low battery condition is indicated as 'BT' when its actual terminal voltage has dropped below about 7 volts.

Range selection is mainly by a front panel rotary switch on both models, which has a quite a light action yet sits positively in each detent position. The switch is arranged with 24 positions on the QM1400 and 20 on the QM1410. The more elaborate QM1400 has an extra two-position switch to select between AC and DC readings for the voltage and current positions, which expands the number of ranges to 32. The additional '10A' socket allows high current measurements for both AC and DC, thereby bringing the total number of ranges to 34 – not bad for under $100.

However the QM1410 is not to be sneezed at either, in value for money terms. Its 20 position rotary switch has two 'off' positions, leaving 18 ranges plus the separate socket for DC currents of up to 10 amps. So that's a total of 19 ranges in a rugged little DMM for less than $60.

Specifically, both models offer DC voltage ranges of 200mV, 2V, 20V, 200V and 1000V, and resistance ranges of 200 ohms, 2k, 20k, 200k, 2M, 20M, with a diode test position. The QM1400 has AC voltage ranges of 200mV, 2V, 20V, 200V and 750V, while the less expensive QM1410 only provides the last two positions.

However, the simpler QM1410 has



DC current positions of 200uA, 2mA, 20mA, 200mA, and 10A (via the extra probe socket), while the QM1400 shares these ranges with the exception of the 200mA capacity. The QM1400 then duplicates the settings for AC current measurements by the action of the front panel AC/DC switch.

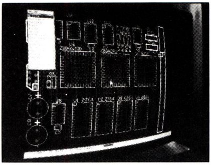
It's beyond this area of basic ranges where the QM1400 becomes rather more interesting, with its capacitance, frequency and logic positions. While a capacitor testing facility is becoming quite common amongst the more expensive DMM's from Asia, the logic probe and frequency counter facilities are less common.

The frequency counter covers at least the audio bandwidth (10Hz to 200kHz) in three switch positions – 2kHz, 20kHz and 200kHz. It also offers quite a useful input sensitivity of 30mV, and a maximum input voltage of 350V RMS. While the input's generous overhead should avoid damage due to excessive voltage at a test point, we couldn't quite raise the courage to test the mains frequency by direct contact with the probes!

The 20MHz logic probe is orientated towards TTL or 5 volt logic systems, with a 'low' logic detected for an input below 0.7V and a 'high' sensed above 2.4V. These conditions are indicated on the LCD by downward and upward facing arrows respectively. As one would expect, an input level between these two voltages is not displayed. As a further indication of a low logic level, the meter's internal buzzer sounds continuously – which could be very handy or a sheer annoyance, depending upon the circumstances.

The capacitance tester is quite a familiar arrangement, with switch positions for 2000pF, 20nF, 200nF, 2uF, and 20uF. Access is via a four-pin socket mounted in the front panel, which allows for two alternative leg spacings of the component under test.

So in practice, these meters should be just the shot for the hobbyist or serviceperson who needs a rugged, inexpensive and well designed little DMM in basic or full featured form. Both the QM1410 and QM1400 appear to meet their specifications with ease, are easy to operate, and offer a handy range of features. Standard accessories include two colour-coded test probes, and a general instruction sheet which covers a range of models, including those supplied for review. Needless to say, both the QM1410 and QM1400 can be seen in the flesh (sorry, high impact yellow plastic) at your nearest Jaycar store. (R.E.)



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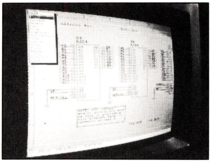

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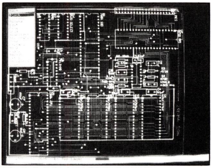

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Test instrument review:

Handheld RC audio oscillator

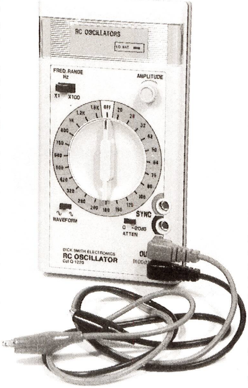
This neat little test instrument from DSE produces sine or square waveforms from 20Hz to 150kHz, in 46 discrete steps.

A basic audio generator must rate alongside the multimeter as one of those essential pieces of test gear for your workbench. In fact once you have one, you wonder how you ever managed without it.

These units are generally mains powered, and housed in an instrument style case with the various controls on the front panel – including a continuously variable frequency adjustment. This control is usually fitted with a dial calibrated in Hertz, while a separate selector switch multiplies the reading to cover the required frequency range.

The DSE RC oscillator on the other hand, is quite a radical departure from this type of design. By sacrificing the ability to continuously adjust the frequency, the setting and readout is taken care of by a 23-position rotary selector switch. The positions cover 20Hz to 1.5KHz, with a 'x100' switch multiplying these readings for an upper range of 2kHz to 150kHz.

Designated the Q-1220, it comes complete with test leads and a 9 volt battery.



By using this method, the manufacturer has been able to use what appears to be a standard digital multimeter (DMM) case and switch assembly. The result is a very portable test instrument measuring 150mm x 82mm x 21mm, which is powered by a single 9 volt battery. Other features include an extra output for synchronising other test gear, a -20dB output attenuator pad, an overall output level control and a low battery indicator.

The oscillator arrived packed in a cardboard carton with an instruction/specification sheet (with the usual curious English), and included a 9 volt battery and set of banana to crocodile clip test leads as standard accessories.

On test the unit delivered quite creditable results, considering its 'low-tech' appearance and modest price – $119 at the time of writing. The output frequency was within 1.7% of the rotary switch markings, while the sine-wave distortion was less than 0.05% THD from 20Hz to 18kHz. At frequencies up to 120kHz, this figure rose to a maximum of 0.3% THD. The output linearity also fared well, with the entire frequency range (20Hz to 150kHz) covered within 0.2dB of the output level at 1kHz.

A quick check of the square waveform revealed quite respectable rise and fall times of 150ns at 1kHz, with less than 1.8% overshoot. The duty cycle remained within 3% of the required 50% figure for all frequencies. Also, all of the above specifications remained unchanged into a 600 ohm load.

By the way, the maximum output level tended to be quite dependent upon the battery voltage, with the unit delivering 1.5V RMS for a 9.0 volt source and 1.2V RMS when the battery is at 7.2 volts. The square-wave figures were 6.8V peak to peak and 5.2V p-p respectively.

Also, the output impedance is quoted as 600 ohm (+/-10%), which proved to be the case, except when the attenuator switch was at 0dB and the 'amplitude' control in its mid position. Here it increased to about double that value, presumably due to the higher resistance as seen by the pot's wiper at this point.

To allow an oscilloscope or frequency counter to be easily synchronised to the oscillator, the extra 'Sync' output is a sinewave fixed at the maximum output via a 1k isolating resistor. This appears to be directly connected to the output of the sinewave generator, before the output level control and attenuator pad.

Since the unit is battery powered, the 'Low Bat' warning indicator is a handy facility. According to the specification sheet, this operates when 20% of the battery life is left – however on test, it activated when the supply dropped to 7.2 volts. The actual current consumption for the unit was a reasonable 9.2mA, rising to 9.9mA when driving a 600 ohm load at maximum output.

So all in all, the DSE RC oscillator is a neat little piece of test gear. It is highly portable, easy to operate and delivers remarkably high quality results – you can check it out at your nearest DSE store. (R.E.)

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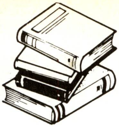

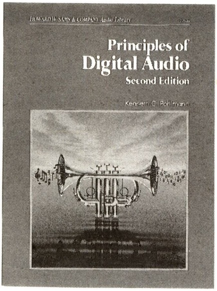
HOWARD W. SAMS & COMPANY Audio Library
Principles of Digital Audio
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Kenneth C. Pohlmann

Digital audio

PRINCIPLES OF DIGITAL AUDIO, Second Edition, by Kenneth C. Pohlmann. Published by Howard W. Sams, 1989. Soft covers, 248 x 190mm, 474 pages. ISBN 0 672 22634 0. Recommended retail price $51.00.

The second edition of this authoritative yet accessible text/reference book on digital audio, which has become widely quoted since it first appeared in 1985. The author Ken Pohlmann should be well-known to *EA* readers, as he contributes excellent articles on the same topic to our own magazine from time to time – as well as writing for many of the US and Canadian audio magazines. Quite apart from writing he is also Professor of Music Engineering at the University of Miami in Florida, USA.

As with the first edition, this extensively revised and updated volume is intended for the audio engineer/technician, hifi enthusiasts and students. It provides a thorough rundown on both the basics and applications of digital audio, from sampling principles right through to compact discs and audio mixing consoles.

For this edition Professor Pohlmann has added a great deal of additional material, including coverage of CD-I, CD-V, DAT (digital audio tape) and DSP (digital signal processing). He has also revised and expanded all of the earlier chapters on basic principles, making them both more helpful and in line with recent developments. This brings it about as up to date as one could get, in any book on the subject. And of course it's all written in the author's usual friendly, yet concise style – making it at the same time readable and understandable by the beginner, yet 'meaty' and satisfying to the professional.

Chapters which attracted my attention in the latter context included chapter 6, dealing with Alternative Digitisation Methods (including floating-point, delta and adaptive modulation); chapter 8, dealing with Error Correction tech niques; chapter 13, dealing with DS and chapter 14, dealing with Digita Audio Workstations (consoles, etc.) These are all particularly satisfying, de spite the sophistication of the concept involved.

As with all good professional texts th author has also ended the book with comprehensive bibliography, for thos wishing to delve further into any of th topics covered.

All in all, then, an excellent volum on a very timely subject – and one tha I can recommend without reservation Like the first edition, I've no doubt tha this one will become a standard text o the subject.

The review copy came from the Aus tralian distributors for Sams books Stewart Electronic Components, of 4 Stafford Street, Huntingdale, Victori 3166, who accept mail orders. (J.R.)

Sound engineering

SOUND SYSTEM ENGINEERING, Second Edition, by Don Davis and Carolyn Davis. Published by Howard Sams, second printing, 1987. Hard covers, 255 x 200mm, 665 pages. ISBN 0 672 21857 7. Recommended retail price $68.50.

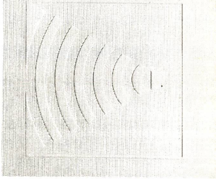
The second edition of another highly respected text/reference book on audio, this time one that deals with sound reinforcement systems – or what used to be called 'public address' or 'PA'. I gather that the first edition of this work by husband-and-wife audio consultant team Don and Carolyn Davis has become virtually the 'bible' of serious PA designers and consultants, both in America and in many other countries.

Looking through this volume, it's easy to see why. It deals with virtually every aspect of the subject, in methodical and comprehensive detail. And to make sure it's all clearly understandable even by those without formal engineering training, the initial chapters give a solid introduction to the basics of engineering maths, decibel calculations, impedance matching, acoustics and electrical-acoustic interfacing.

Following these introductory sections there are chapters on the acoustics of both large and small rooms, designing for speech intelligibility and acoustic gain, microphones and microphone measurements, loudspeakers and loudspeaker arrays, using delay devices, installing and equalising systems, and audio and acoustic instrumentation and measurements. And each chapter ends with a fairly comprehensive bibliography, for further reading and reference The book itself ends with a set of 1 data appendices. The emphasis through out is on a serious engineering approac to all aspects of sound reinforcemen and audio, and on thorough analysis o performance parameters – mainly usin the TEF (time-energy-frequency) analy sis method.

Overall a very impressive referenc book, which belongs on the referenc shelf of anyone with a serious interest i audio-acoustics and sound reinforce ment engineering.

The review copy came from Stewar Electronic Components, the Australia distributors for Sams, who are at 4 Stafford Street, Huntingdale, Victori 3166. Copies are available from thi firm directly, via mail order. (J.R.)



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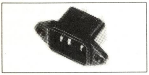
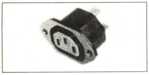


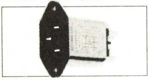
IEC Female Chassis Socket

Reverse sex 3 pole appliance outlet rated @ 6A/250V. Mates with L2298 rewireable connector. Panel cutout 34mm x 27mm with 3.5mm holes on 40mm centres. **L2292 $4.10**



IEC Male Chassis Socket

3 pole appliance inlet rated @ 6A/250V. 2.8mm solderless/ solder terminals. Colour - black. Panel cutout 28.5mm x 21mm with 3.5mm holes on 40mm centres. **L1950A $2.50**



IEC Inlet Filter

3 pole filtered appliance inlet with 4.75mm quick connect or solder terminations. Panel cutout 28.5mm x 21mm. 3.5mm holes on 40mm centres.**L2131C/S $26.50**

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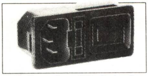
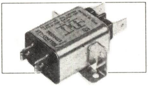


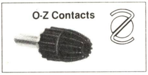
IEC Fused and Switched Inlet

Rated @ 6A/250V this appliance inlet, complete with integral switch and 20mm x 5mm fuse, requires a single 27.2mm x 61mm panel cutout. Snaps in for easy mounting with 4.75mm snap on terminations **L2723 $16.75**



Chassis Mount Filter

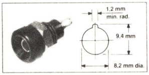
Rated @ 6A/250V this chassis mount filter is effective over 0-400 Hz. Complete with 6.3mm Faston/solder terminations. **L2140/6L $26.50**



O-Z Contacts

4mm Banana Plug

Rated @ 6A these 4mm plugs use the Belling Lee "O-Z" contact. Contacts are silver plated phosphor bronze. Available colours black, blue, green, red, white and yellow. **L378/4/colour $1.90**



4mm Fixed Socket

Rated @ 6A this 4mm fixed socket has a 11.1mm round face. It requires a 8.2mm diameter panel cutout. Contacts are silver plated phosphor bronze. Available colours black, blue, green, red, white, yellow.**L1413/colour $1.10**

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26LS34	Quad Diff Receiver	Ten for **$9.00**
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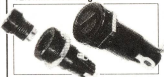
8253-5	P.I.T.	Ten for **$80.00**
AM27S191	2048x8 Bipolar Prom	Ten for **$96.80**
Z8430	Counter/Timer Chip	Ten for **$60.00**
Z8400	CPU	Ten for **$60.00**

Fuse Holders

Panel Fuseholders -M205 Size

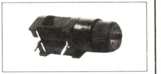
Miniature fuseholder rated @ 6.3A with solder terminations. Coin slot in head. Requires 12.9mm mounting hole.



L2006A $4.05 **L2002 $3.40**

Panel Fuseholder - 3AG Size

Finger proof, rated @ 10A with solder terminations. Coin slot in head. Requires 12.9mm mounting hole. **L2004A $8.25**



PCB Mount Fuseholder - M205 Size

Enclosed fuseholder rated @ 6.3A with coin slot in head.
L2179 - 3 Pin Version $3.60
L2180 - 2 Pin Version $3.60

Open Fuseholder - M205 Size

10 way PCB mount strips rated @ 6.3A. They can be subdivided into lesser number of ways. On 10.16mm centres. **L2222/10 $5.95**

Open Fuseholder - 3AG Size

12 way assembly rated @ 7.5A. They can be subdivided into lesser number of ways. On 12.7mm centres. **L1746/12 $13.25**

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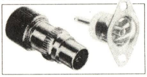

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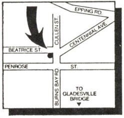

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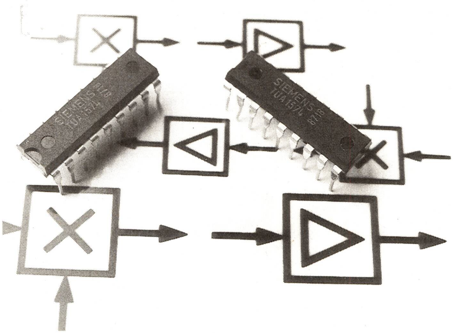
Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY



VHF tuner chip

To allow good VHF reception in spite of the growth in interference sources, Siemens has developed the TUA 1574 tuner chip. Great symmetry has been observed in the circuitry of the TUA 1574 for the mixer and decoupling stages, to avoid reaction from the input on the oscillator, as far as possible. The large-signal characteristics are enhanced by a low input resistance (grounded base configuration). A low-noise oscillator caters for high spectral purity.

The chip is designed for input frequencies of up to 150MHz. The frequency is considerably higher than the upper limit of the FM VHF broadcast band (108MHz) which is increasingly becoming a feature of high-grade radios. With 'background reception' a second tuner can be used to scan for other frequencies of a broadcast program, whilst the program is still being received on a frequency with deteriorating reception on the 'foreground receiver'. The automatic transition from one program frequency to the other then takes place more rapidly and with less disturbance.

For further information contact the communications equipment department of Siemens, 544 Church Street, Richmond 3121 or phone (03) 420 7314.

New GAL devices

New GAL (Generic Array Logic) devices from National Semiconductor emulate the full range of PAL architectures with 100% socket compatibility. They can even be configured to all the in-between architectures like 16R1 or 20R7. You can change architecture during the design process. And when your design is complete, you can move functions from pin to pin to simplify your board layout.

The GAL devices combine a high performance CMOS Process with electrically erasable floating gate technology. The programmable memory technology applied to array logic provides designers with reconfigurable logic and bipolar performance at much reduced power levels.

For further information contact your local George Brown Group office or The George Brown Group Marketing Division, 456 Spencer Street, West Melbourne 3003 or phone (03) 329 7500.

EEPROM-based analog processing chips

Atmel Corp of San Jose, California has announced a programmable amplifier/delay equaliser aimed at applications in telecommunications and data communications. The part is the first in a family of EEPROM-based analog circuits that will include other telecommunications products and progammable devices for use in data communications applications like the integrated services digital network.

The approach is said to be particularly useful in cellular and portable telephone applications, where the EEPROM capability allows an appropriately designed system to minimise bit-error rate, improve the sound quality of a particular radio channel, and vary the rate as the portable telephone moves from location to location. When used with standard linear functions such as ADC's and DAC's EEPROM-based designs achieve higher accuracy and linearity because the parts can be calibrated periodically by modifying code contained in the memory.

The first Atmel part, the AT76C10E, incorporates 4Kbits of EEPROM on the same chip as two anti-aliasing filters, a delay equaliser, two gain amplifiers, four control registers, a microprocessor interface, and clock-generation circuitry. The amplifier/equaliser is fabricated using a 12V, double-metal, double-polysilicon CMOS process orginally developed for building Atmel's high speed, high-density, 256Kbit EEPROMs.

The AT76C10E is designed to be used as part of an adaptive equaliser in medium-to-high-speed modems – those operating at 1,200 to 19,200 bits/s. By using it a systems designer can minimise bit-error rates over dial-up and leased line and in cellular telephones. the designer does this by allowing the gain and delay response to be modified in ıeal time, using a serial seven-bit configuration code. The code is loaded into the chip through a serial input port and updated periodically as conditions change.

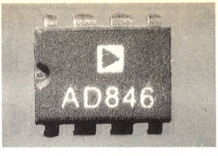
For further information contact Energy Control International, 26 Boron Street, Sumner Park 4074 or phone (07) 376 2955.

High speed precision op-amp

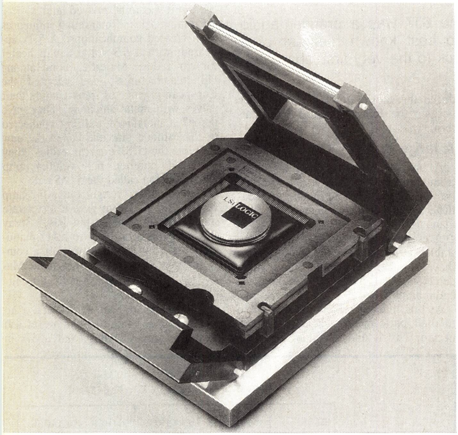
A monolithic op amp for high-speed, precision applications features AC characteristics that remain nearly constant with increasing gain. Analog Devices' AD846 uses current feedback to provide a 46MHz gain-bandwidth product at gain of -1, and 31MHz at gain of −10, along with 110ns settling to 0.01% for a 10V step. The DC precision specifications, settling time, and 450V/us slew rate make this device well-suited for 12-bit applications in A/D and D/A converter buffers, subranging A/D converters, wideband multipliers, line drivers, and advanced audio circuitry.

Maximum offset voltage is below 75uV with offset voltage drift of 3.5uV/°C, with open-loop transimpedance of 200M ohms.

In application, the DC transfer function of this op amp is set by source and feedback resistors, just as in voltage-feedback op amps. Unlike conventional op amps, however, the closed-loop AC response is determined by the feedback resistor alone. This eliminates the usual design tradeoff of required gain versus achievable bandwidth.



For further information contact Parameters, 1064 Centre Road, Oakleigh 3167 or phone (03) 575 0222.



524-pin plastic SMT package

Just five years ago, packages with 200 pins and 50 mil (0.5″) lead centres were considered state-of-the-art. But now LSI Logic has introduced a new family of plastic surface mount chip packages, featuring as many as 524 pins and 10 mil (.01″) lead centres.

The Milpitas company said the family consists of eight 'Tape Quad Flat Pack' packages with pin counts between 164 and 524 pins.

The TQFP packages are designed to accommodate highly complex ASIC circuits.

According to Cy Hannon, LSI's vice president of manufacturing, the new packages feature better noise immunity than commercial ceramic packages through the use of an integral ground plane and – unlike any other package in the market – by accommodating the use of the chip's own capacitors.

Zilog produces TV controller

In a bold move to compete head-on with the Japan-based leaders in consumer electronics ICs, Zilog has introduced a state-of-the-art television controller that will enable most television manufacturers to easily add many advanced control and on-screen display features to their future sets. The company also unveiled a next-generation communications controller that offers four times the performance of the current industry transmission standard, reducing CPU overhead by some 60%.

At a recent press conference in Santa Clara, Zilog showed a prototype of a Korean-made television incorporating the Zilog Z86C27 chip. Using a remote control, the demonstration showed how users will be able to manipulate virtually every control function, including volume, bass/treble, balance, contrast, picture clarity and colour with their infrared remote control.

With a maximum display capability of 128 characters, the controller even has a calculator function built-in which will allow users to do most basic calculations on their television screen.

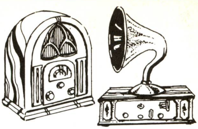
With an eye on the rapidly growing television market in Asia, particularly the PRC the on-screen display can be switched from Roman characters to Japanese or other language characters by flipping a simple switch mounted on the back of the set.

Both the Z86C27 and the Z18C30 communications controller are part of Zilog's new generation of "Super-Integration" devices which incorporate numerous functional VLSI cells, including Zilog's 8-32-bit microprocessors, as many as five memory cells including RAM, ROM and Video RAM, and various other logic and I/O functions.

In all, the 1.5-micron CMOS-based chips incorporate more than 160,000 transistors. The USC (universal serial controller) chip, with a data transfer capability of up to 10 megabits per second, will be able to facilitate current and future high-end microprocessors, including the 80386, 68030, and most of today's RISC processors. At that rate, the USC chip is about four times as fast as any industry-standard SCC part.

Vintage Radio

by PETER LANKSHEAR



The 6J7 'fraternity'

For more than twenty years, the 6J7 was a premier audio voltage amplifier valve, and the best known member of a large family whose origins go back to the very first 'sharp cutoff' RF pentode of 1932.

The story more or less starts in 1929 when, after a lot of research and effort, a successful indirectly-heated screen grid RF tetrode was developed. This was the 2.5 volt heater type 224, later to become the 24A, and – together with the superheterodyne – it revolutionised receiver design. A year or so later the 236, a 6.3 volt version for car and DC mains radios was released.

At the beginning of 1932, the 6.3 volt heater 'variable-mu' RF pentodes types 239 and 244 were announced, and it was obviously only a matter of time before 'sharp cutoff' pentodes would appear.

Sharp cutoff pentodes

By June 1932, the 2.5 volt type 57 was in production as the sharp-cutoff pentode successor to the 224/24A. Along with its variable-mu type 58 partner, the 57 was physically innovative. Instead of using the traditional pear-shaped S bulb, it introduced the new ST envelope with the domed top which was soon to become standard for all types of valves.

Internally, the cylindrical perforated shield which had been standard in previous RF valves had been replaced by a shallow shield, positioned in the domed section above the elements. This type of construction and the particularly tall ST12 bulb was confined to relatives of the 57 and 58 and, interestingly, the Australian 2.0 volt directly heated RF pentodes – including types 1K5G, 1K7G and 1M5G.

Another Australian connection was that, along with the 2A5 and 80, the 57 and 58 were the first valves produced by Amalgamated Wireless Valve Co.

Very shortly afterwards, an equivalent pair of 6.3 volt pentodes designated 77 and 78 appeared. These retained the traditional perforated shield and introduced the shorter form of bulb, which became the future standard ST12 pattern.

A large family

Although physically different, apart from their heater ratings the characteristics the 57 and 77 were practically identical, a fact not mentioned in the valve manuals for some years. With a 25% greater mutual conductance, and more stable performance than the tetrodes, they soon became popular for mixers, detectors, AGC and to a limited extent, audio amplifiers.

At this time, no reference was made to their performance when triode connected. This is understandable, as adequate and cheaper triodes already existed; but it was to be revived later.

Commercial and marketing influence soon created complications. A 57A ap peared, with a 6.3 volt/0.4 amp heate for car radios. Majestic, alone amon US manufacturers, had adopted th European practice of spray coating thei valves with metal shielding. They gav the 57 a metallised coating, connecte to the cathode pin, and called the ne creation the 57S. For car radios, the produced another 6.3 volt/0.4 am heater version called the 57AS.

Majestic later brought out a 0.3 am version, the 6D7, but gave it a separat shield pin on a seven-pin base! Spra shielding was a problem to other manu facturers who wished to market a complete range of spares, so they made Majestic-type replacements with close fitting tinplate shields.

The Canadian firm of Rogers, wh had ties with Majestic, and were als fond of spray shielding, had a 57s i

RECEIVING TYPES

BASE	6.3 VOLT HEATER	OTHER VOLTAGES
6 PIN	77 77E 77s 87s 57A 57AS 6C6	(2.5v) 57 57s 57S
7 PIN	(Small 7 pin US) 6D7	(13.0v) (7 pin British) 8D2
OCTAL	6J7 6J7MG 6J7G 6J7GT Z63 KTZ63 6Ж6 (Russian) 77M 6J7M	(12.6v) 12J7GT
OCTAL (Triode)	6C5 6C5MG 6C5G 6C5GT	
NOVAL	6BR7/8D5	

Table 1: The main receiving tube members of the 6J7 family, grouped in terms of base and heater voltage.

roduction by mid 1932. However, in his case, the shielding was not conected to the cathode, but relied on hassis mounted contact fingers for earhing. Soon they were also making 6.3 olt versions of the 57; the 87s with a .4 ampere heater and the 77s with a .3 ampere heater. Note that Majestic sed an upper case S suffix and Rogers enerally a lower case s.

Following the introduction of the RF entodes, all new R.M.A. valve types were produced with both 2.5 volt and .3 volt heaters, as for example, the A7 and 6A7. The 2.5 volt series was ntended for AC operated domestic reeivers, with the 6.3 volt types for DC mains and car radios.

By 1934, marketing people were demanding something to make last year's models obsolete. Some manufacturers, including the giant Philco, had realised two years earlier that the 2.5 volt series was becoming an anachronism, and had standardised the 6.3 volt types for all classes of receiver, using for some of their export receivers the 77E, which seems to be identical with the 77. Now 6.3 volt valves were 'in'. The only major change necessary in many models was a different heater winding on the power transformer.

Although the 77 and 78 would have been quite satisfactory for the new sets, there had to be something new. Consequently, the 57 and 58 were given 6.3 volt heaters to become the 6C6 and 6D6.

NDUSTRIAL TYPES

SE	TYPE	MANUFACTURER
PIN	1603	RCA
	1603	BRIMAR
	1603	AWV
	7700	KENRAD
	1221	SYLVANIA
TAL etal)	1620	RCA
TAL lass)	1603/1620	AWV
	7000	KENRAD
	1223	SYLVANIA
	A863	MARCONI OSRAM
VAL	6059/6BS7	BRIMAR

Table 2: The less common 'industrial' or premium grade members of the 6J7 family.

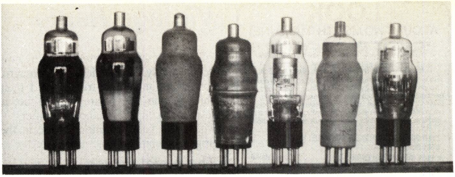


Fig.1: Some of the first generation in the 6J7 family. From the left, a Kenrad 57; a blue glass Arcturus 57; a Majestic 57S; a Raytheon 6D7 replacement with metal shield; an RCA 6C6; a Rogers 77s and a Sylvania 77 with Philco label.

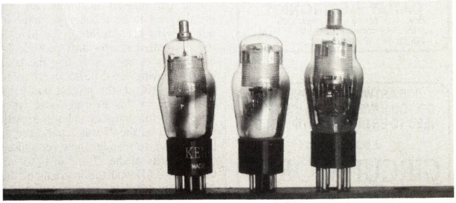


Fig.2: Brothers under the glass – from left to right, a 6J7G, a 6C5G and a 77. The 6C5 triode was actually a 6J7 without the suppressor grid, and with the screen grid tied internally to the plate.

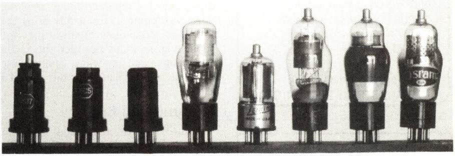


Fig.3: A selection of octal members of the family. From the left, an RCA 6J7; an RCA original-shape 6C5; an RCA 6C5 in the later shape; a Kenrad 6C5G; a Sylvania 6J7GT with Zenith label; an Australian (AWV) 6J7G; a Sylvania 6W7G; and a Marconi Osram KTZ63.

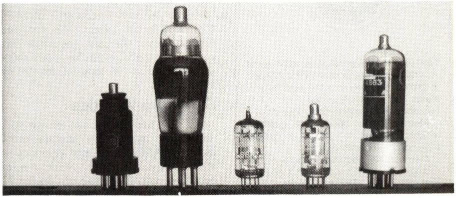


Fig.4: Less common types. From the left, an RCA 1620; an RCA 1603; a Brimar 6BR7/8D5; a Brimar 6BS7/6059; and a Marconi Osram A863.

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The sharp-cutoff pentodes had by now been largely superseded by pentagrid converters and diode-triodes, and their chief use in the future was to be as resistance-coupled audio amplifiers – which had been a minor feature in the original specifications.

The metal valves

One of the landmarks of valve production was the introduction in mid-1935 of the 'octal' based metal valves made by RCA.

Had the original intentions for the metal valves to be a complete range of new designs been realised, the 6J7, as the designated sharp-cutoff pentode, is likely to have been more like the later 6SJ7 – leaving the 57/77/6C6 group to languish. Instead, the project was a bit of a fiasco in that existing valve types were used for many of the series, with the result that the 77 was repackaged as the 6J7. Valve manuals now recognised the similarity of the 77 and 6C6, for although the 6J7 had the internals of the 77, it was stated to be identical to the 6C6.

Previously the use of sharp-cutoff pentodes had been declining, but as the metal series had no combined valve with diodes, a separate audio amplifier stage was required, frequently using the 6J7. The expanding broadcasting and public address industries used the 6J7 in increasing numbers, whilst another use was as a local oscillator for the new 6L7 mixer.

The unusual 6C5

A further twist in an odd saga was the metal general-purpose triode. To save time, advantage was taken of the previously mentioned excellent triode characteristics of the 6J7 to produce the 6C5. Apart from the suppressor grid, the 6J7 electrode assembly was used intact – but with the screen grid internally connected to the anode. This construction was never changed, and when glass versions emerged, even the anode shield was retained, a very unusual feature for a triode.

Still more varieties

Already the family had grown to a dozen, but many valve manufacturers, including AWV, were not equipped to make the metal range. Some put an octal base and small grid cap on the 77, to create the 6J7G. Others made 'metal' valves by covering equivalent glass types with cylindrical iron shields. These were given the MG suffix, but soon disa
peared from the market.

Three more versions were to be pr
duced in the USA. The compact 'G
series appeared in 1939, and include
the 6J7GT and for AC/DC receiver
the 0.15 amp/12.6 volt heater ty
12J7GT. Finally, to complete the
family, there was for battery operati
a 6.3 volt/0.15 amp heater, octal bas
version of the 6C6 called the 6W7G.

Foreign varieties

Rogers once again came up with no
standard valves. Their response to t
6J7 was the black painted metallis
77M and 6J7M. These had octal bas
but retained the large grid cap.

Two British companies who had clo
ties with the US also produced the
own versions of the 6J7 famil
Marconi/Osram made two, the KTZ6
similar to to the 6J7G and the Z63,
tall tubular octal based 6C6.

STC, as well as marketing the stan
ard range under the 'Brimar' labe
made three unusual versions of the 6J
The 8D2 had a British 7 pin (B7) bas
and 13.0 volt/0.2 amp heater. They als
made two miniature 9-pin Noval typ
with scaled down and non-microphon
elements for critical applications: th
single ended 6BR7/8D5, and the indus
trial 6BS7/6059 with a top grid cap.

Industrial types

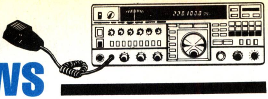
Professional users in areas such a
broadcasting and the film industr
found several of the family very useful.

In this type of service, first cost is n
as important as reliability and consis
tency. Production runs were pu
through extra stringent microphon
noise, leakage and characteristics test
Suitable specimens were selected as pre
mium valves and given identificatio
numbers chosen by individual maker
RCA for example produced the 6C6 a
the 1603, and the metal 6J7 as the 1620

AWV did not make metal valves, bu
called their premium version of th
6J7G the 1603/1620! Industrial type
that I have been able to locate are liste
in Table 2.

I wonder if, back in 1932, the design
ers of the 57 would have believed tha
in 1960, the 6J7, which was essentiall
the same valve, would still be given
major listing in the RCA catalogue
That it was can be attributed in part t
the panic production of the meta
valves, but also to its excellence as a
audio amplifier.

Amateur Radio News



S-E Radio Group Convention

The South East Radio Group (SA) is again holding its popular convention over the Queen's Birthday long weekend in June this year.

As usual there will be many interesting trade displays and used equipment ables, plus the opportunity to catch up with many old friends. For those who do not wish to compete in the many exciting events, there is ample space to sit and talk or to browse around if this is your desire. This coupled with excellent food makes for a very pleasant weekend in an equally pleasant city.

For the first time this year the South East Radio Group is hosting the Australian Fox Hunting Championships, with the permission of the Wireless Institute of Australia. As the Group is renowned for offering plenty of excitement in this area, it feels sure that the competition will be fierce. In additon to the normally great prizes, there will be additional ones for the winner of the Australian Fox Hunting Championship.

All readers with an interest in amateur radio are urged to come and spend an enjoyable weekend with us on 10-11 June 1989. Should you decide to attend, accommodation will need to be organised as quickly as possible as Mount Gambier plays host to many functions at this time. Further information and registration forms can be obtained from the Convention Coordinator, PO Box 1103, Mt Gambier 5290 or by contacting Trevor Niven VK5NG, or Graham Roesler VK5YM.

Amateur population

A recent news item from the equivalent of the WIA in the United States of America, the American Radio Relay League (ARRL) advises that the number of licensed radio amateurs in the USA has surpassed 440,000 for the first time in history.

The Federal Communications Commission figures as at 27th December 1988 showed a total of 440,311 licensed amateurs. This is particularly pleasing to the ARRL, considering the recent concern about the possible slowing down of growth in the number of radio amateurs in the USA.

By way of comparison, the latest figures for radio amateurs in Australia licensed by the Department of Transport and Communications as at 30th September 1988, was 18,026, which included 239 repeaters and 38 beacons.

Some other interesting amateur population figures show the United Kingdom with approximately 66,750 licensed radio amateurs; Indonesia with 61,350; West Germany with 60,900; Canada with 24,400; the Soviet Union with 18,600; and New Zealand with 6,600.

Interference to radio and TV

In the past the Australian Government has provided a free service, through the agency of the Department of Transport and Communications, whereby skilled technical officers investigated the causes of interference to television and radio reception. Virtually all of these cases of interference were resolved on a technical basis.

The WIA has been advised that the Government has decided to cut costs by requiring an up-front fee before any investigation of interference complaints is undertaken.

Recently, the Professional Radio & Electronics Institute has been conducting a campaign opposing this concept of charging a fee, mainly based on the argument that control of the radio spectrum is the responsibility of Government, and that interference-free reception should be a right of every citizen in this country.

In discussions on this matter at the WIA/DOTC Joint Meeting held near the end of 1988, a DOTC spokesman advised that a DOTC Task Force was being set up to study the feasibility of introducing a fee structure for investigating interference complaints.

This DOTC spokesman gave an assurance to the WIA that, if one of the options to be considered was to be that the person causing the interference is to be charged a fee, the WIA will be consulted.

Also at that WIA/DOTC Meeting, the DOTC representatives told the WIA that "there is some concern in political circles that the rights of TV viewers and broadcast listeners are being subordinated to the rights of a relatively small number of amateur stations".

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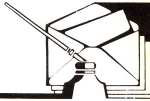

Conducted by Peter Phillips

Some earthy issues

From water reticulation systems through reducing the carbon dioxide content in the atmosphere to hot chassis TV sets. It's all here this month, and more...

I always look forward to preparing this section of the magazine. I never know until it's finished what will come out the other end; almost a magical mystery tour. This month covers the greenhouse effect (again), with some rather fascinating solutions to the problem. On the technical side we have a suggestion for a video transmitter design, and I get carried away talking about how to handle a hot chassis TV set.

I already have quite a pile of material on hand for next month, but I would like readers to supply me with some questions, similar to the 'Why?' I regularly provide in this column. I can think of numerous technical questions that may require a bit of thought to answer, but I would prefer your questions, with answer if possible. It makes for more variety. Oh yes! Any technical stories that have a bit of humour would also be appreciated.

Greenhouse effect

The following compilation of letters concerns an original suggestion by D.B. of Darwin that varying the length of the sun's rays electronically may be a possible solution, amongst other things, to the greenhouse effect. Response from readers suggests considerable interest in this topic, and the following are extracts from some of these letters.

Unfortunately, none of our writers feels that fiddling around with the length of the sun's rays is either technically feasible or useful. However, the responses do offer suggestions for dealing with the greenhouse effect and one letter gives a succinct explanation why it's cooler in winter and warmer in summer. We'll have that letter first...

Any change in temperature between summer and winter is not caused by sunlight having to travel further in winter due to the tilt of the Earth's axis (although there is some attenuation because the path through the atmosphere is lengthened), but rather because the same amount of sunlight is falling on a larger area in winter than it does in summer. Same energy, more area means the intensity is less and the average temperature is lower.

For this reason electronically shortening or lengthening sunlight, however this may be accomplished, will not solve the problem. (B.L., Mount Beauty, Vic)

The sentiments of the above letter are echoed by other correspondents, so it seems this explains summer and winter. Next are some suggestions about the greenhouse effect. All the writers agree that the industrialised world is to blame by pumping too much carbon dioxide into the atmosphere. The next letter explains the effect and offers the obvious solution, and the others provide some rather interesting methods of solving the problem.

The greenhouse effect is the mechanism by which carbon dioxide in the atmosphere prevents the release of radiant energy back into space. Since there is a build-up of carbon dioxide in the atmosphere, which has occurred since industrialisation, more radiant energy is trapped – which therefore increases the temperature at the earth's surface and changes the weather.

It is up to the person on the street to understand that by judiciously using the earth's resources, and applying technology effectively, i.e., using less fossil fuel, the greenhouse effect can be averted. (M.F., St Marys, NSW)

There is an alternative fuel source for the motor car which seems to have been forgotten, one that doesn't add to the carbon dioxide content nor use our finite resources. As far back as 1946 small German staff cars ran on hydrogen fue one tank of water to four or five table from a vial kept in the glove departmen I saw it in operation, as the small European town in which I lived had only on roadside water tap, and the occupatio officer often filled up at this tap durin the last two years of the war.

And how about controlling the weather... Imagine the arguments about deciding when it should or shouldn't rain. W would have weather lobbies, protes meetings, even sit-in's – during the fin periods of course! (M.B., Derby, WA)

It would seem that we cannot contro our use of fossil fuels sufficiently to kee the carbon dioxide content of the atmosphere to reasonable levels, with th greenhouse effect being the price we ma have to pay. But there are means to reduce the carbon dioxide content.

An already proven method is the on that nature used to clean up the primeva atmosphere, with plants. Normally plant extracts carbon dioxide from th air as it grows, then dies and decays returning carbon dioxide to the air. This i referred to as the carbon cycle and to remove the carbon dioxide it is necessar to break the cycle, preferably by preventing decay.

Nature achieved this by having th dying plants fall into water, which prevented total decay and locked up the carbon in what are now our present da coal deposits.

So what we have to do is divert all the money spent on so-called defence into creating thousands of square kilometres of peat bogs, which are the first stage in locking up the carbon.

Given the advances in genetic engineering, scientists should be able to improve the natural peat bog plants to the stage where they can keep up with the rate that we are pouring carbon dioxide into the air. The peat bog idea would store the carbon for future generations and would be self regulatory to some extent, because as the carbon dioxide thinned out in the atmosphere the plants would grow more slowly. (C.A., Port Lincoln, SA)

Now to more electronic matters. Our ext correspondent asks a simple question, in a manner that I found rather ntertaining:

Watering system

I have a little problem that you or one of your underlings may be able to answer.

I wish to reticulate my backyard but because of several factors, low water pressure being one of them, I need about 30 stations. I could purchase various four channel or six channel reticulation controllers, but I got to thinking? Why can't my IBM PC do it?' I own an XT with a few bits of ice cream on it so here are the questions:

1. *Does anybody make a doodah that my computer can talk to, which could control singly or in multiples, up to 50 solenoid operated reticulation valves?*
2. *If these things aren't made, is a kit form available?*
3. *If neither of the above, what do you reckon? (B.H., Sway Gap, WA)*

While I cannot recall a kit for an I/O board directly suitable for such a task, I am certain such a device (or doodah) would be relatively easy to design. As a start, our Real World Interface (various issues 1988-1989) would be a step in this direction. It can provide eight digital outputs, and by stacking four boards, a total of 32 outputs can be generated. By using another output port on the computer, this can be repeated to give up to 64 outputs. Not as elegant as one might like, but a possibility nonetheless. Driver circuits for each solenoid would also be needed, operated by the digital signals from the I/O interface.

Having visited many computer shows, it is apparent that a wide range of commercial digital output boards for the IBM range of computers are available. These boards may not include drivers for solenoids, nor even run to 50 outputs, but something suitable is very likely to be available. Just try the 'ice cream' department of any computer peripheral supplier...

The rubberised IC

A recent court case in Dublin is causing concern to the IC moguls around the world. We are told that a class action has been successful in establishing that the humble DIL package IC should be classified as a 'dangerous weapon'.

The court action was initiated by an employee of an electronics repair shop, who was unfortunate enough to swallow a 555 timer. The action was originally taken against the employer who was able to deflect the blame to the IC manufacturer. However, other sufferers came forward during the hearing, showing a range of scars (8 pin to 40 pin) on various parts of their anatomy.

Most of the injuries were caused by the afflicted having sat on an upturned IC, with stepping on an IC running a close second. In fact a certain amount of rivalry took place concerning the number of pinpricks, although the process worker who actually sat on two strategically placed Z80s was voted the winner.

We are told by a very reliable source that the judge has recommended that IC pins be manufactured from a material that would bend before breaking human skin. Could it be that the day of the rubber IC is at hand?

Video transmitter

I am a regular reader of the projects produced in EA, and, being a secondary school teacher am always on the lookout for projects that might be useful in my job. Also I enjoy building projects that might be nifty gadgets to have around the house.

I have built several projects over the years, and regularly use the EA large screen digital storage CRO in classroom studies of sound waves and ECG waveforms.

For some time now the school has been making a variety of FM microphones. Some of these use a small linear amplifier following the oscillator stage. My suggestion stems from this simple method of transmitting a signal over reasonably short distances.

If a linear amplifier can be used to allow an FM audio signal to be transmitted, it should be possible to do the same with a video signal. All video recorders have an RF output that is modulated with the composite video/sound signal. If this output was amplified by a suitable linear amplifier, surely this would be sufficient to allow that signal to be received by any TV in the house, providing it was tuned to the correct channel.

There are commercial products that accept a video and an audio signal from a VCR, then modulate them onto UHF channel 36 for transmission to any TV within 30 metres. I am curious as to why they don't just use a linear amp.

Because most VCRs output on channel 3 or 4, it should be possible to make a linear amp that can handle either one or the other without much trouble. It may even be possible to make a separate device for those VCRs that output on a UHF channel.

I trust this suggestion for a project is a workable one, and that we might see it soon. I would be interested in any comments you have regarding this idea. (K.B., Sunbury, Vic)

- Firstly, it's great to know that electronics is alive and well in the school system. You are obviously a dedicated teacher, K.B.

I discussed your idea with other EA staff members, and our collective opinion is that – yes – your idea should work. Whether our technical expertise is sufficient to produce such a project without the Department of Communications getting fidgety is another question.

The main problem with any transmitting device, particularly one that would be operating for long periods of time is the likelihood of interference to other receivers. A linear amplifier would need to be very linear to prevent the generation of harmonics that could cause interference on other TV channels.

If the power level was kept very low, then perhaps interference may not be a problem. Anyway, thanks for the idea, K.B., and as time permits we'll see if it can be done. If any readers have some thoughts on this, or maybe even a design, we would like to hear from you.

Hot chassis earths

Here's a letter concerning my article on fault finding published in December 1988. It raises the issue of the 'hot chassis' appliance. *In your article 'Basic techniques of fault finding' EA Dec 88, page 31, you show a diagram captioned 'Many TV sets are hot chassis. Use an isolating transformer to make it safe to work on'.*

You do not make it clear to me, or perhaps to other readers, whether the TV set's chassis should be earthed when the isolating transformer is used. Some TV sets have the chassis at a potential above true earth of around 115V AC. Can I earth this type of set when it is operated through an isolation transformer.?

I believe 'The Serviceman' touched on this subject recently, but as TV internal common rails are often not connected to chassis or earth, the question of where to put the mains earth is vital when attach-

Why??

Most readers have probably heard of the term *skin effect*. My question this month is what *causes* this effect? Many readers will know how to overcome the effect, even what it is – but what causes it and why is it more apparent at high frequencies?

ing earthed test equipment.

Perhaps EA could publish the design of a suitable isolation transformer for use in TV servicing. (R.G., Toowoomba Qld)

The 'hot chassis' TV or computer monitor has always been a nasty when it comes to servicing. There are various ways in which the set may be hot, but the most typical seems to be that where the power supply rectifier connects directly to the mains, and the negative terminal of the rectifier goes to the common rail. This means that regardless of the way the active and neutral terminals are connected, the common rail (chassis) is always above true earth.

The auto transformer is another variation, where interchanging the active and neutral can put the chassis at the active potential. Switching power supplies usually have the mains applied directly to the input rectifier, and then have an isolating transformer after the switching circuitry. This means all the circuitry up to the primary of the transformer is 'hot'. From the secondary on, there are no problems.

As R.G. points out, the metal chassis may not always be connected to the common rail of the set, although I suspect this is rather uncommon. So how does the serviceman connect his earthed tested equipment to a hot chassis TV?

Before answering, let's look at what a voltage is. Put simply, a voltage is a potential difference existing between two points. Often one of these points is connected to mother earth, in the interests of safety. We could now launch into a discussion on the merits of having all voltages, the mains in particular, not related to earth. The important point is that a voltage is relative to earth if, and only if, one end of the voltage source is actually connected to earth.

However, the output of an isolating transformer is *not* relative to earth – the potential only exists between the two terminals of the transformer. This means you can touch either terminal, even though the potential difference between them is 240V AC, as neither terminal has anything to do with Earth, or Mars or anything else. If there was such a thing as a 240V battery, it is obvious that either end of the battery can be touched, providing you don't hang on to both ends at once.

Of course, you need to be careful if a fault occurs in the isolating transformer, in which a section of the winding actually gets connected to mother earth, perhaps with a leak to the earthed frame. Then the potential becomes referenced to a third point, this time the earth or ground you are standing on.

So, assuming the transformer doesn't have a fault, then you are quite at liberty to touch either of the terminals, bare feet on a concrete floor and all. Ignoring the effects of stray capacitance, that is.

But is it permissible to connect either one to earth, perhaps through the earth lead of a CRO? Why not? It's the same as taking the fictional 240V battery, and connecting one end to earth. You will only get into trouble if the transformer (or battery) has an earth fault in the first place.

It is really quite simple when you examine the situation this way. Providing the isolation transformer does not have an earth leakage problem, you are dealing with a 240V battery. You can earth one end if you wish, or leave it all floating. In practice, it is probably best to earth the chassis anyway, mainly for your own protection against the transformer suddenly becoming faulty. To be sure the isolating transformer is free of any earth faults, try measuring the voltage at either terminal with respect to earth. Naturally, the transformer frame should be earthed, and it may be that a high impedance voltmeter will respond by showing a voltage. This will indicate some form of leakage from the secondary, and will probably disappear if the terminal is connected to earth with a 1M resistor. If it doesn't, fix the transformer.

If the chassis of the set is not connected to the common rail, then it is not much point using it as a connection point for test equipment. You would need to find the common rail itself. Again, you can earth the chassis and the common rail during servicing, mainly for your own peace of mind.

One final point is that the VA ratin of the isolating transformer must b high enough to handle the power take by the set. Early model colour TV set can consume up to 250W, meaning very large isolating transformer is required. That's another reason why w don't think publishing a design woul be a good idea. Apart from the safet aspects, such a project would be quit expensive and difficult to build.

NOTES & ERRATA

BEAT-ME

(March 1989): Capacitor C1 is a 33n metallised polyester, not 3.3nF a shown on the circuit. The parts lis should also show *two* 0.1uF monolithi capacitors, rather than one, for C7 an C8. (File 1/EM/63)

SUB-WOOFER ADAPTOR

(May 1989): The 250mm sub-woofe used in the August 1982 ?100W Sub-Woofer Enclosure' design is availabl from Jaycar Electronics, both directl via its stores and by mail order, as catalogue number CW-2119. It is not currently available elsewhere.

CAR BRAKE LAMP MONITOR

(April 1989): The LED was not listed i the parts list. It is a standard 5mm type. red or orange as desired. (File 3/AU/56)

SIMPLE TESTER FOR POWER TRANSISTORS

(May 1988): The last resistor in the parts list should read 180 ohm 1W, rather than the repeated 100 ohm 1W listing as shown. Also, the push-button switch must have *normally open* contacts. (file 7/VT/19).

RADIO & TV LISTINGS

(January 1988): The operating frequency for commercial AM radio station 5MU in Murray Bridge, South Australia should have been shown as 1458kHz.

Answer to last month's Why??

Last month we asked how the sine and square waves relate. The answer lies in the complex mathematical series expounded by Fourier. Put simply, if you take a sine wave of a frequency equal to the fundamental (the frequency of the square wave) and then add a number of *odd* harmonics (multiples of the fundamental), you will end up with a square wave.

For example, if a 1kHz sine wave is combined with diminishing proportions of a 3kHz, a 5kHz, a 7kHz (and so on) sine wave, a 1kHz square wave will result. The perfect square wave needs an infinite number of harmonics but i practice, a reasonable square wave results with the presence of only the thir and fifth harmonics.

This raises many issues, including the necessary bandwidth of an audio amplifier if a square wave is to be adequatel reproduced. It would seem, for example, that if a 20kHz square wave mus be reproduced, the amplifier shoul have at least a 100kHz bandwidth.

It also explains why a square wave, o any wave with fast rise and fall time generates interference on a radio. Although the switching frequency may be only a few kilohertz, the harmonics will extend up to the radio frequency spectrum, and cause the interference.

eletext Decoder

Continued from page 89

hrough level clamps formed by D7, D6 nd D5, with the clamp level adjusted y VR3 via Q19, and then via buffers 16, Q17 and Q18 to the MC1377 PAL ideo encoder (IC9).

IC9 basically converts the RGB video ignals from IC4 to a standard compos-te PAL colour video signal, synchro-ised with the incoming video. Its com-osite video output appears at pin 9, nd then passes through output buffer 7.

The 4.433MHz crystal XL3 is used to enerate the Teletext colour subcarrier, ia an oscillator circuit inside IC9. Tran-istor Q20 is used by the CPU chip IC8) to turn the oscillator on and off, o enable or disable the colour. This is one via a control signal fed out of pin 26 of IC8.

In the subtitle or newsflash mode, the CPU will turn the colour off so that the Teletext subtitle or newsflash message does not have colour. This prevents conflicts with the rest of the TV picture content.

The infra-red (IR) receiver section of the decoder is based around the uPC 1373 IR preamp and conditioner chip (IC6), fed by the IR detector diode PD1. The output from IC6 is squared up by a Schmitt trigger formed by transistors Q13 and Q14. The IR pulse train is then presented to a port of the CPU chip, via pin 8.

The decoding of this pulse train is done in software, aided by an inbuilt timer in the CPU chip (IC8). The CPU itself is reset upon power-up by the action of C22.

The CPU chip's clock is actually derived from the 6MHz output from the VIP chip (pin 17) and passes through a high-speed CMOS flip-flop (IC7), a 74HC74, configured in a divide-by-two mode. As there is some variance in the accuracy of the resulting 3MHz, this is not severe enough to compromise the operation of the chip's control program.

Power for the Teletext decoder is derived from a 2155-type stepdown transformer, with a centre-tapped 15V secondary. Diodes D1-4 form a bridge rectifier, feeding a 7812 three-terminal regulator (IC1) for the +12V supply rail. At the same time the centre-tap of the transformer secondary is used to feed a separate 7805 regulator (IC2), to produce the +5V rail.

Remote control unit

The remote control transmitter for the decoder is based on a single SAA 3004 dedicated encoder chip (IC1), designed specifically for this application (see separate circuit).

IC1 includes a clock oscillator, which uses an external 455kHz ceramic resonator (RES1) as the frequency determining element. It also includes scanning circuitry for the key matrix, via seven drive lines (pins 13-19) and four sense lines (pins 5-8). The ADRM sense input (pin 9) is used for programming the chip's addressing and transmission mode.

The output from IC1 is in the form of a digital signal emerging from pin 1, in the form of pulses whose relative positions form codes for the various control functions. This signal is fed to transistor Q1, which drives the series-connected IR emitting diodes LD1 and LD2. The complete remote control unit operates from a 216-type 9V battery.

The second of these articles will describe the construction of the unit and the optional TV receiver front-end module.

Tuned Loops

Continued from page 95

ity for both loops, but point out that it greatly reduces the need for an antenna rotator. In terms of construction, the spiderweb coil appears to be simpler to construct than the copper tube coil.

Conclusion

Multi-turn loops tuned remotely using varicap diodes operate satisfactorily. Tuned loops reduce interference from mains switching and TV line scan to more tolerable levels, but, as with passive loops, do not eliminate it. Breakthrough interference from adjacent stations is also reduced, but not eliminated.

Compared to a large, single turn passive loop, tuned loops are compact, easier to connect to typical receivers and have less constraint on lead-in length. The observed lack of directionality may be a blessing in disguise because an antenna rotator is not essential unless seeking very weak signals, such as 2KY when received in Wagga.

The copper tube coil performs well, but with its sharp tuning and temperature drift in the BB212's, may demand re-tuning during the day with weak stations. The signal level with the Sony ICF2001 is ample, being similar to that achieved with the 20m wire and antenna tuner. However, because a tuned loop has a low output away from its tuned frequency, finding weak stations using a receiver without a digital tuning indicator can be very frustrating – believe me!

In terms of dollars, the copper costs around $50 and the fibreglass, resin, buffer amplifier, cable and variable DC supply will take the total materials bill close to $100!

Whether the performance of this coil justifies its cost and outweighs the need for an additional tuning adjustment must remain a matter of personal choice.

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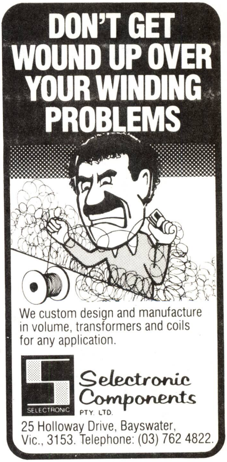

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50 and 25 years ago..

"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

RADIO AND HOBBIES IN AUSTRALIA

June 1939

Metal tape recording: The new method of recording onto tungsten steel tape is not expected to be any more expensive than the more popular methods. It avoids the necessity for photocell equipment, does not suffer from needle wear, is practically free from breakages and is quick and permanent.

Background noise is almost non-existent and after 17,000 playings it is claimed that the loss does not exceed 5dB. The recording can be wiped out when required and the tape used again. Coiling the tape does not affect its permanence and a temperature of 250°C is required before it will affect the recording.

The steel tape, which measures 120mm wide and 8mm thick, winds round four cylinders, one in each corner of a housing, 35 times to make a rectangular coil. Then it cuts across the diagonal, inside the coil, and joins again to the beginning. A small motor keeps the tape in continuous motion. The endless helix has a recording length of about 360 feet for recordings of two minutes.

RADIO, TELEVISION and HOBBIES

June 1964

TV by telephone: A British firm is e perimenting with an improved system transmitting television signals over tel phone cables. Because of their limite capacity these cables cannot carry th enormous amount of information th goes to make up an ordinary televisio picture, but the new system – calle pulse code modulation – enables enoug of it to be transmitted to provide a re sonable picture.

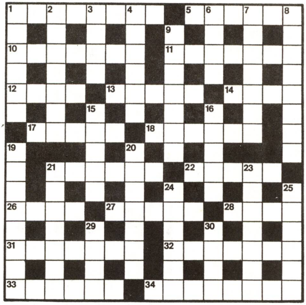
Facsimile newspaper: The first facsimi newspaper transmission system in E rope has been inaugurated b Sweden's Dagens Nyheter (Expresse using British designed equipment. Th system makes possible the simultaneou printing of the newspaper at widel separated places.

A whole page is placed on the tran mitter and, in 10 minutes, a negative received at the distant printing hous Similar equipment has already bee supplied to Japan's Asahi Shimbun an America's Wall Street Journal.

JUNE CROSSWORD

ACROSS

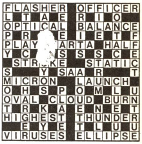
1. Garble a message. (8)
5. Electronic funds transfer at point of sale. (6)
10. Type of galvanometer. (7)
11. Name of fundamental theory. (7)
12. Change in polarised light due to voltage, the —— effect. (4)
13. SI unit of magnetic flux. (5)
14. Region of electromagnetic spectrum, the —— infrared. (4)
17. American standard code for information interchange. (5)
18. Display area. (6)
21. Unidirectional devices. (6)
22. Images on a radarscope. (5)
26. Russian physicist noted for induction law. (4)
27. Particles. (5)
28. Strip insulation (from wire). (4)
31. Secondary development from original research. (4-3)
32. A —— field theory links gravitional and electromagnetic fields (7)
33. Experimental space station. (6)
34. Sensor. (8)



DOWN

1. Visible discharges. (6)
2. What a CRO spot does in flyback. (7)
3. Non-specular. (4)
4. Fixed (e.g. on a frequency). (6)
6. Cause of malfunction. (4)
7. Design. (7)
8. Metallic element number 62. (8)
9. Noise suppression control. (7)
15. Indicator, or —— lamp. (5
16. Magnetic unit. (5)
19. Ascertainments of constituents. (8)
20. Convert form of current. (7
21. Property of matter. (7)
23. Noteworthy keyboard operator. (7)
24. Said of semiconductor with additive. (6)
25. Device that recovers recorded data. (6)
29. Stellar outburst. (4)
30. Connected to a p.d. source. (4)

SOLUTION FOR MAY



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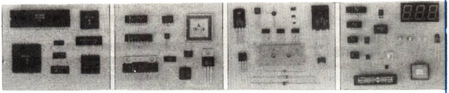

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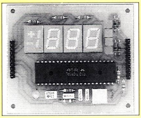

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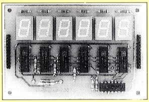

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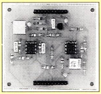

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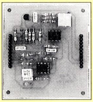

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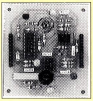

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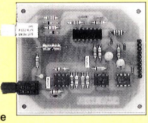

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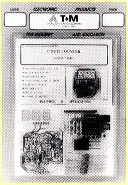

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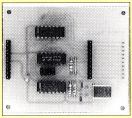

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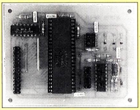

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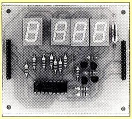

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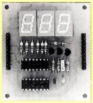

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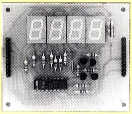

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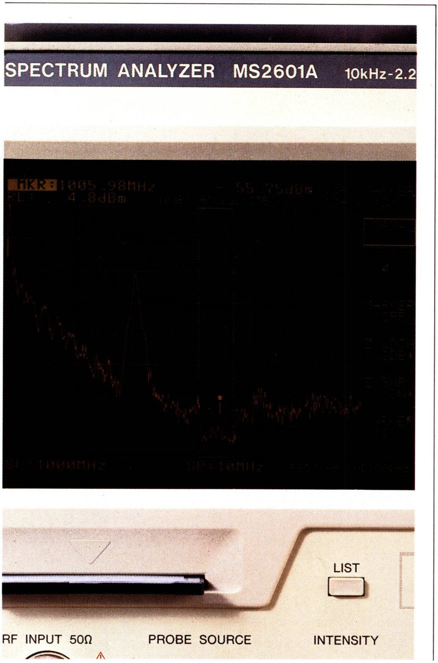

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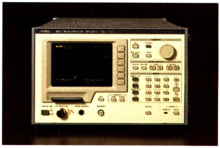

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